The British Journal of Surgery

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In this system the name of the author and the date of the publication are given in the text; the list of authors quoted is put at the end of the article in alphabetical order. Each reference in the list should give, in order, the author's name, initials, the year of publication (in brackets), the full title of the paper,* the name of the journal, the volume (in heavy type arabic numerals), and the number of the first page of the paper. If the author cited has written more than one paper in the year, each should be distinguished by the letters a, b, and c, etc. For books, the place of publication should be stated and the publisher's name. The names of collaborating authors should be given in full on the first occasion, but in later citations the words "and others" should follow the first name.

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THE
BRITISH JOURNAL OF SURGERY

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TEMPORAL LOBE EPILEPSY * †

BY WILDER PENFIELD, MONTREAL

JOHN HUNTER was a surgeon, a mechanic like other surgeons. But he was also the " founder of scientific surgery ", and his penetrating thought ranged ever beyond the appearance of disease to body mechanisms normal and abnormal. Disregarding the precepts of the medical past, he took Nature for his text-book and Experiment for his teacher.

During his years of surgery, of experimentation, of anatomical dissection and tireless collection of specimens, he adopted the true scientific approach. This was something new—but for him was no more than the turn of his mind. It was an inborn trait in this Scot, like his intolerance of authority, his irascible temper, his boundless energy, his unfailing drive to put all thinking to the test. A surgeon he was by profession ; a scientist by preoccupation.

John Hunter is dead ; but not his spirit, for that spirit lives on in the Royal College of Surgeons of England, where young men of vision will discover it as you and I have done. It seems to dwell here within these walls and among the specimens in this museum. Nothing can shake the hold he has upon us and our successors, neither bursting bombs nor the passage of time.

Like Osler, among his own precious books in the Osler library at McGill, Hunter makes his home here. But his influence works like a ferment among surgeons everywhere—in Canada and the United States and in every land where surgeons pause to consider cause and effect and to put constructive thinking to honest test.

So it is, in many ways, that the leadership of this nation is not lost. We have been moved to see the crowning of Queen Elizabeth II. By a mysterious magic that is all her own she has charmed men 'round the world, has confirmed their faith in the power and virtue of spiritual leadership.

1. INTRODUCTION

The title of my discourse is ' temporal lobe epilepsy '. But if I am to explore this subject as a Hunterian Lecturer should, a simple clinical account is not enough. I must add :—

a. Description of the pathological anatomy and a consideration of the mechanism of its production ;

b. Discussion of symptomatology ;

c. Conclusions that contribute to general knowledge ;

d. A discussion of surgical technique that is practical ;

e. A summary of surgical results that is honest.

All this within a period of time that will not try the patience of surgeons too severely, for I fear the disciples of John Hunter are, many of them, as intolerant of platitudes as the Founder of Scientific Surgery himself.

Epilepsy has always been a concern of major clinical importance. Surgeons have approached the problem empirically from the days of prehistoric trepanation onward. Indeed, Sir Victor Horsley's first three craniotomies were undertaken for the cure of focal epilepsy (1886). The several causes were—a post-traumatic cyst of the brain, tuberculoma, and brain scar. This was at the dawn of neurosurgery, for these cases were reported by Horsley in a three-page article entitled ' Brain Surgery '! (Horsley, 1886.)

But the results of early surgical therapy for recurring epileptic seizures were a disappointment. Cushing reported 59 cases in which epilepsy was treated surgically, but ' extirpation ' was actually carried out in only 13. A thoughtful approach to the problem was made by Otfried Foerster (Foerster and Penfield, 1930). He concerned himself chiefly with seizures due to traumatic injuries of the brain.

Advance in understanding of the epilepsies was made possible by the neurologists Hughlings Jackson, William Gowers, Gordon Holmes, Kinnier Wilson, Charcot, Marie, Dejerine, and by the rise of the science of electrophysiology and electro-encephalography in the hands of Berger, Adrian, Kornmüller, Jasper, Gibbs, Lennox, Walter, Bremer, and Gastaut.

The epilepsies may be divided into groups according to the location of the discharge that produces the fits in each case. The Jacksonian hypothesis that every seizure originates in some area of cerebral grey matter has been amply verified by modern methods. Analysis of the whole field by electro-encephalographers makes it evident that the patients who are subject to temporal lobe seizures are more numerous perhaps than the sufferers in any other single group, even when idiopathic or essential epilepsy is taken as one of the subdivisions.

It was Hughlings Jackson who pointed out that illusions of perception and transient hallucinations

* Hunterian Lecture of the Royal College of Surgeons, delivered on July 8, 1953.

† From the Department of Neurology and Neurosurgery, McGill University, and the Montreal Neurological Institute.

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or dreams might, in themselves, constitute minor seizures. These he described as dreamy states. He showed that a small tumour situated in the uncinate gyrus of the temporal lobe might cause the patient to experience an olfactory aura, followed by a ' dreamy state ' or a period of automatic behaviour for which the subject would have subsequent amnesia.

We would include Jackson's uncinate fits, his dreamy states, and the automatisms, in the somewhat more embracing group of temporal lobe seizures. Curiously enough, the pathological change responsible for such attacks is most often in the general vicinity of the uncus, including the amygdaloid nucleus and the hippocampal gyrus.

2. PATHOLOGICAL ANATOMY

Complete destruction or removal of areas of brain does not cause epilepsy. On the other hand, an incomplete lesion of the grey matter may become epileptogenic (Penfield and Jasper, 1954). Acute attacks may occur at the time of brain injury, but chronic, recurring seizures make their appearance only after the lapse of time. During this ripening period a biological change takes place which cannot be visualized under the microscope although it can be detected electrographically.

Before inquiring into the nature of this progressive alteration it is well to recall the fact that the living nerve-cell is different from other cells in the body. It is ready to be fired off when a normal neuronal impulse reaches it, and it sends impulses outward along its own axone instantly. The power for these impulses is generated by the cell with explosive speed. All this is normal.

On the other hand, ganglion cells may become abnormally active when subjected to a long-continued pathological state. They may then discharge themselves in groups synchronously and, as it seems, spontaneously. Such an excessive group discharge may be strong and brief and ineffectual like the flicker of distant heat lightning. If, at such a time, an electrode has been placed upon the area, the recording pen of the ink-writer rises and falls sharply, leaving a mark that the electrographer may call a ' spike '.

The excessive discharge may be of longer duration, continuing until the cells of that group, and perhaps contiguous or connected groups, exhaust themselves. This may be said to constitute an epileptic seizure. It is large or small, major or minor, grand mal or petit mal, depending on whether the initial discharge is restricted to the cell group of origin or whether it spreads to other areas because of the great intensity of the local discharge or the receptive condition of the ganglion cells at a distance.

It is the abnormal, the partially destroyed area of grey matter, that may develop this state of regional hyper-irritability. One might be tempted to believe that the ganglion cells in this area may be irritated by a slight degree of anoxæmia or that there is an over-supply of some irritating substance that interferes with normal electrical insulation.

A slowly growing neoplasm may compress the cortex for years before seizures result. The origin of these attacks is then found to be in the cortex near the tumour where circulation seems to have been reduced to the critical level required for the appearance of mass discharges.

A brain wound begins to produce seizures months or years following the accident. The focus of discharge is not the scar or cyst that was produced, nor is it the normal cortex at a distance. The focus is found to be in the narrow atrophic gyri between scar and normal cortex.

Partially destructive cerebral anoxæmia of brief duration, such as may occur during birth compression, may leave behind scattered areas of permanent abnormality, such as partly atrophied gyri. The pressure of growth on the part of normal neighbouring convolutions may crowd the atrophied gyri together into an area of microgyria.

As far as the production of seizures is concerned, these shrivelled gyri may remain dormant for long periods (5, 10, even 20 years) before they ripen into epileptogenic foci. It seems strange that a gyrus which occupies no more than a fraction of its normal space should come in time to take on independent and dominating activity, but so it is.

Let me give a brief example :—

The patient, G. A.,* was a young woman who suffered from focal epileptic seizures. At the time of operation the right postcentral gyrus was found to be atrophied, while the rest of the hemisphere was comparatively normal. Indeed, in the hand area the gyrus was no more than 2 mm. in width and had actually disappeared below the surface where the normal neighbouring gyri had crowded together over it. Except for that buried portion, the gyrus was removed completely.

It is about fifteen years since operation. She is happily married and fortunately has had no more major seizures. But from time to time she continues to experience a tingling sensation which involves only the hand. This sensory seizure no longer spreads into leg and face, as formerly. That would be impossible, for these portions of the sensory gyrus were removed. The recurring discharge could scarcely be arising anywhere except in that shrivelled gyrus.

This case illustrates the fact that natal compression can produce isolated ischæmic lesions and further that such partially destroyed areas of grey matter can continue an epileptic discharge indefinitely.

Gross Character of Temporal Lesions.—In the temporal lobe, these and other agents may produce an epileptogenic focus.

With the help of my associates, Maitland Baldwin and K. M. Earle (Penfield and Baldwin, 1952; Earle, Baldwin, and Penfield, 1953), I made a study of pathological material from 157 cases of subtotal temporal lobectomy. The operative removal had been carried out for the radical treatment of temporal lobe epilepsy. Patients who showed pre-operative evidence of increase of intracranial pressure were eliminated from this series.

A few of these patients had indolent tumours, scars of healed brain abscesses, scars of brain injuries, or vascular abnormalities. Such lesions are familiar in other areas of brain without being peculiar to the temporal lobe. But 63 per cent of them, that is,

* The case G. A. was described in detail by Penfield and Jasper (1954).

100 out of 157, had localized areas of cortical atrophy which were considered to be the result of birth compression. The conclusion that these areas were actually produced by birth compression was reached after reconsideration of the history and the radiological, electro-encephalographic, and operative findings, as well as pathological study.

The overlying pia mater and the pial vessels were often thickened, and after the pia mater was removed the underlying cortex was found to be tough, sometimes almost leathery in consistency, the colour more yellow than normal, and the width of convolution narrower.

There was increase in fibrous astrocytes in both grey and white matter. In some specimens scattered areas of loss of ganglion cells were discovered. The increase in fibrous gliosis might be so great that the specimens could easily have been mistaken for astrocytoma or harmatoma. In some cases there were scattered minute cysts.

Incisural Sclerosis.—The location of this sclerotic change was the same in almost every case. It was most intense in that part of the temporal lobe which is next to the midbrain and lies upon the free edge of the tentorium, i.e., the uncus and hippocampal gyrus, as shown by the shading in *Fig.* 415.

This is the portion of the temporal lobe that is farthest removed from external violence. How, then,

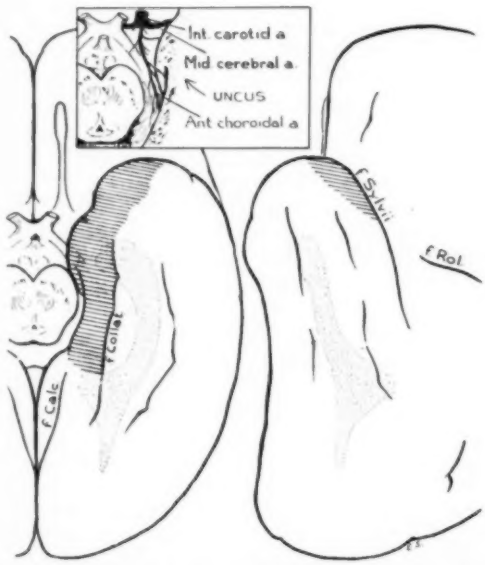

FIG. 415.—Incisural sclerosis. The portion of the temporal lobe that is often most severely compromised by birth compression is shaded. (*From Earle, Baldwin, and Penfield,* 1953.) *See also Fig.* 417.

could an ischæmic lesion be produced here? It occurred to us some years ago that this portion of the temporal lobe might be caused to herniate through the incisura of the tentorium as the result of head compression during birth. It seemed obvious, moreover, that if herniation did occur the arteries which cross the incisura would be compressed temporarily. That would affect the anterior choroidal artery and branches from the posterior cerebral artery, as shown in *Fig.* 415 and its inset.

To put this supposition to the test, my associates, Earle and Baldwin, took stillborn infants and bound the head about with an elastic bandage under some pressure. Following this, the head was frozen solid. The cranium was then sawn through. Herniation did occur, and one could readily believe that, were the child alive, the flow of blood through the arteries that crossed the incisura would have been arrested

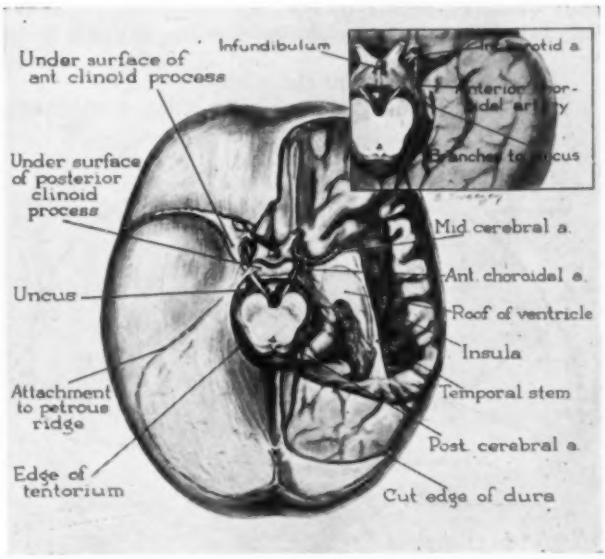

FIG. 416.—Drawing of arteries that vascularize the incisural portion of the temporal lobe, drawn from the adult human brain. At birth the anterior choroidal artery is comparatively larger in calibre. (*From Earle, Baldwin, and Penfield,* 1953.)

until after the pressure was released (Earle, Baldwin, and Penfield, 1953).

The experiment seemed to substantiate the hypothesis. Further support of this line of reasoning has come from the fact that in some cases of severe sclerosis of the uncus and hippocampal gyrus, herniation was still present at the time of operation. Portions of this zone of the lobe were found at operation to lie as much as 1 cm. inside the incisura in what seemed to be a hollow formed in the side of the midbrain.

The anterior choroidal artery at birth is quite large ; as large, in fact, as the middle cerebral artery. *Fig.* 416 is from a drawing of that artery and the temporal branches of the posterior cerebral artery in an adult brain. It seems quite possible that the extent of cortex vascularized by the choroidal artery may well be comparatively larger at birth than it is later in life.

It seems clear that temporary compression of these arteries and possibly a branch of the middle cerebral arteries might produce an ischæmic lesion of the first temporal convolution anteriorly and deep in the fissure of Sylvius. It might also produce a varying degree of injury of the inferior surface of the temporal lobe and the amygdaloid nucleus which lies just beneath the uncus.

The hypothesis seems to have become a reasonable theory, and we have not been able to discover any other reasonable explanation of the distribution of this sclerosis. We propose to call the lesion *incisural sclerosis.*

3. SYMPTOMATOLOGY AND SEIZURE PATTERNS

Under this heading we may include all those things that serve to guide the surgeon to the epileptogenic lesion :—

a. **Sensory Auras.**—The sensory auras that are apt to appear early in the evolution of a temporal lobe seizure and often constitute the first warning may be listed as follows :—

Trunk sensation (abdominal aura, thoracic aura, nausea).

Head sensation (cephalic aura).

Limb sensation (thermal or tingling sensations).

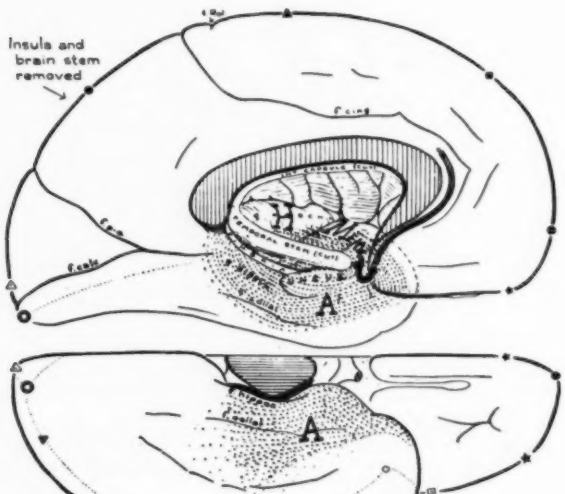

FIG. 417.—Incisural sclerosis on inferior-mesial and superior surfaces. **A,** Overlies area in which stimulation produces automatism and amnesia. **H,** Heshl's gyrus ; **Mem,** Part of cortex in which stimulation may activate memory records.

Auditory sensation (ringing, buzzing, etc.).

Equilibratory sensation (vertigo).

Olfactory sensation (sharp or disagreeable odour).

b. **Psychical Phenomena.**—In addition to these sensory auras there are psychical phenomena (dreamy states) : hallucinations, illusions, automatisms.

Psychical Hallucinations are brief states during which the patient is aware of the enactment of an experience which is not the present experience. It is in addition to the present experience. During it he may seem to hear or see people and places which, as in a dream, are drawn from past experience. The patient may seem to play a role in the hallucinatory event and yet may retain some awareness of his present environment.

Psychical Illusions are sudden alterations in his judgement of present experience. The illusion may give him a false sense of familiarity as though all this had happened before (*déjà vu* phenomenon). On the other hand, things may seem strange or absurd. Things seen or heard may seem abnormally close or, on the contrary, far away. The patient may be suddenly frightened or have a feeling of ' loneliness ' or that he is himself far away from his environment.

During all of these phenomena, whether the patient is experiencing a sensory aura, a psychical hallucination, or a psychical illusion, he may retain a continuing awareness of his actual surroundings. He may realize that the attack is likely to go forward and may prepare himself for it by lying down or leaving the room. At such a time he may struggle against it in some way. This sort of doubling of consciousness was referred to as ' mental diplopia ' by Jackson.

Automatism : This state may appear with, or without warning. During automatism there is an alteration of consciousness, but it cannot be said that consciousness is completely lost.

The essential feature of automatism is that there is complete loss of ability to record present experience. There is paralysis of the mechanism of memory recording, and the patient will later have amnesia for the period.

He is able to move about, to see, to hear. He may carry out stereotyped acts, may utter unrelated words, or execute a previously intended course of action. He is for the time being an automaton, more or less devoid of reason and of normal understanding.

Automatism may be preceded by tonic stiffening which suggests the employment of the extrapyramidal motor system rather than discharge in the Rolandic area of the cortex. During automatism or at its beginning there is frequently salivation and movements of mouth and throat suggestive of mastication.

Localized discharge in grey matter, or localized electrical stimulation of the cortex of conscious patients at the time of operation, produces the foregoing phenomena in the following general areas :—

Psychical hallucinations and illusions are the result of discharge in the temporal cortex of the lateral and superior surfaces of the lobe exclusive of the auditory cortex of Heschl's gyrus (**H** in *Fig.* 417).

The abdominal and cephalic auras and the other sensations of limbs and body seem to point to a localization deep within the fissure of Sylvius and often near to the insula.

Automatism appears when the discharge includes the neighbourhood of the amygdaloid nucleus—beneath the uncus—and it can be produced by deep stimulation with a coated electrode here (**A** in *Fig.* 417).

Radiographic study frequently betrays some abnormality of the temporal lobe. In a case of incisural sclerosis which results from an ischæmic compression at the time of childbirth, the middle fossa of the skull is often shown to be small, the floor shallow, or the petrous ridge high. Pneumography may or may not show slight enlargement of the inferior horn of the ventricle.

Electro-encephalography is of great importance. In 1938, Gibbs, Gibbs, and Lennox called attention to the existence of a group of epileptics to which they applied the term ' psychomotor '. The brain-waves were often characterized by a 4–6 per second rhythm which they considered to be generalized to all head regions. It was later recognized, as pointed out by Jasper and Kershman in 1941, that the discharge may be localized in the temporal regions. We recognize now that it most often appears in one temporal region as a primary phenomenon.

Spike discharges can usually be detected arising in the temporal region before operation, although it may be necessary to precipitate a seizure by metrazol administration. Electrocorticography during operation rarely fails to detect the location of an epileptogenic lesion.

Electrical stimulation of such an area of cortex usually produces the aura or the beginning of a typical attack at the time of operative exposure under local anæsthesia. This serves the purpose of added confirmatory evidence.

4. FUNCTION OF THE TEMPORAL CORTEX

Evidence derived from the study of temporal lobe epileptics suggests that the grey mantle that covers the superior and lateral surfaces of each temporal lobe contains a ganglionic record of human experience. Epileptic discharge or electrical stimulation occasionally causes memories of past events which are stored there to be reproduced within the patient's mind in the most exact detail. These records are evidently deposited in duplicate in the two temporal lobes.

5. SURGICAL TECHNIQUE OF TEMPORAL LOBECTOMY

The cranial opening should be made as low in the temporal region as the mastoid air cells will permit, as outlined in *Fig.* 418. The scalp incision may be kept within the hair-line and just posterior to the frontalis branch of the facial nerve.

The procedure is carried out under local anæsthesia (nupercaine with adrenaline), but as a preliminary to operation it is essential that the surgeon should have taken time to explain the procedure and to make friends with his patient.

The scalp is cleaned with physoderm and sterilized with iodine. Ultra-violet light is used to kill airborne organisms. Towels folded over sheets of pliofilm are sutured to the scalp and lifted so that the patient can see the anæsthetist or an observer and is able to talk with him freely. No sedative is used except codeine when needed. Finally, during closure of the wound, sleep is induced with pentothal and sometimes gas and oxygen.

The scalp-flap is turned down and the bone-flap follows in turn, retaining some attachment to the temporal muscle. The dura is opened and its edges are sutured with silk to the periosteum, which has been carefully preserved on the cranium around the bone incision. The brain is protected from air exposure by pliofilm except when it is necessary to uncover it.

Cortical mapping is carried out by use of a unipolar electrode. The current is supplied by a square wave generator provided with flexible control of voltage and of pulse duration. The position of the Rolandic gyri, motor and sensory, is determined, using the minimum voltage stimulus required to give responses.

Electrocorticography is carried out, placing the recording electrodes on the surface of the cortex so as to discover the general location of abnormalities of potential.

Electrical stimulation is employed in an effort to reproduce the beginning of the patient's habitual seizures. The voltage of stimulus may be increased if necessary to twice that required for minimal response in the sensory and motor area. If desired, deep stimulation may be used as follows: The current is turned off. Then the unipolar electrode, which is coated except at the tip, may be thrust through the brain to grey matter deep within the fissure of Sylvius. When ready the current is switched on and the result observed.

Decision for or against excision and the extent of excision depend on the discovery of cortex which

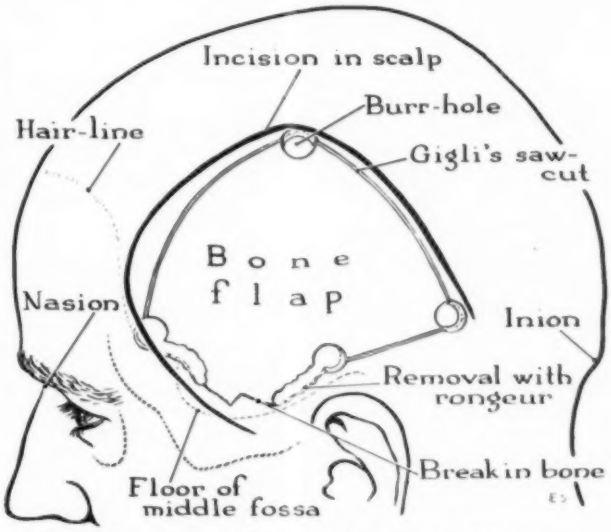

FIG. 418.—Outline of routine surgical approach for exposure of temporal lobe.

is grossly abnormal and which is the origin of electrographic spike discharges, as judged by electrography. Reproduction of seizure aura is very helpful but not always possible. Not infrequently the lateral aspect of the temporal lobe has a normal appearance even though there is incisural sclerosis of the hippocampal region. The recording electrodes may be placed there and the stimulating electrode as well, to explore what cannot be seen. Thus it may be necessary to remove what seems to be normal lobe in order to reach the abnormal.

In the dominant hemisphere identification of areas of the cortex essential to speech is possible if the patient is asked to name objects while the stimulating electrode is applied to the cortex. The electrical current interferes with speech and the patient becomes aphasic until the stimulator is removed. In general, however, the temporal lobe can be removed on the dominant side to the extent of 5 or 6 cm. measured along the fissure of Sylvius and 7 or 8 cm. along the floor of the skull without fear of anything more than transient aphasia. Removal of the hippocampal gyrus and inferior surface of the temporal lobe does not produce aphasia.

Ablation.—When cortex is being removed the circulation of remaining cortex must be preserved with great care. It has become our practice to follow fissure lines wherever possible and to make a sub-pial removal (as first employed by Horsley for the motor region). When a convolution must be crossed, the cut is made as clean as possible.

I have found that a short angulated metal sucker, such as is shown in *Fig.* 419, with an inside bore of 0·08 in., is most satisfactory. There should be an opening in the side of the tube which may be closed by the thumb so as to vary the force of suction.

The vein of Labbé usually crosses the temporal lobe diagonally (*Figs.* 419, 420) and fissures are found beneath it which serve as an excellent frontier of removal. The first temporal convolution may be sucked out first, exposing the insula and the middle cerebral arteries upon it.

In *Fig.* 420, the preservation of middle cerebral vessels on the insula is illustrated and the section of temporal stem as well. The preservation of the pial boundary along the mesial portion of the lobe is also illustrated. It is usually necessary to carry the actual removal further posteriorly than illustrated, next to the midbrain. This must be done in order to get out the abnormal hippocampal gyrus in its full extent.

At the end of the operation the dura is closed completely and with considerable care, using fine

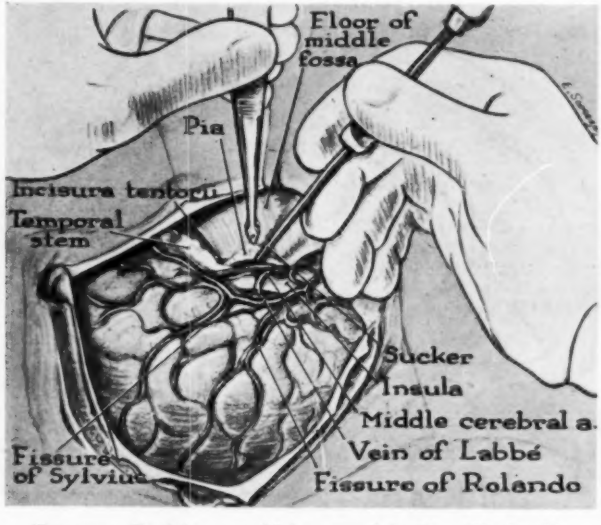

FIG. 419.—Partial temporal lobectomy, left side. The head is upside down as seen by the surgeon at operation.

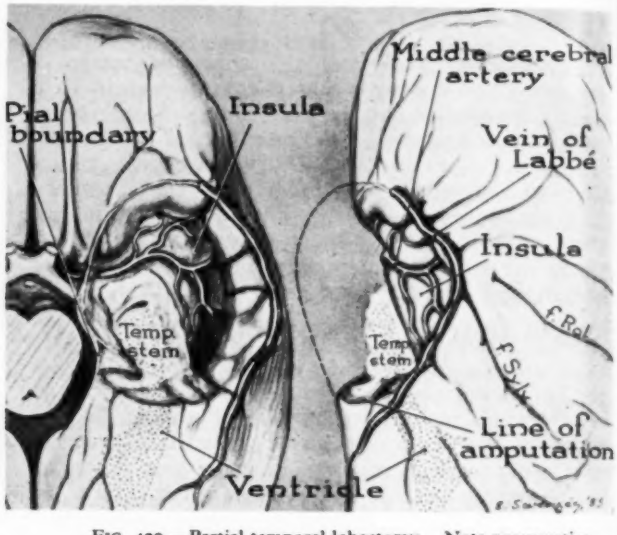

FIG. 420.—Partial temporal lobectomy. Note preservation of pial membrane along the mesial line of ablation. The excision is usually extended farther than is shown in the drawing posteriorly around the midbrain so as to include all or most of the hippocampal gyrus.

Injection of the trigeminal ganglion with nupercaine is advisable at this stage, for traction on temporal veins which cross the subdural space may become painful. If the lobe is lifted the ganglion may be palpated with a small instrument. After injection the veins become insensitive. If large arteries on the insula happen to be sensitive this ganglionic injection will render them insensitive as well.

The most important, and the most difficult, part of the procedure is the removal of the convolutions which form the inferior and mesial margin of the temporal lobe. This manœuvre is shown in *Fig.* 419. The pia mater which covers the uncus and hippocampal gyrus and separates them from the subarachnoid cistern about the midbrain is preserved and the convolutions are sucked out. This pial layer is held in the thumb forceps in *Fig.* 419. In cases of incisural sclerosis these convolutions are rubbery and tough.

Removal by suction is largely restricted to grey matter, but eventually the temporal stem which is composed of white matter must be crossed and the anterior end of the inferior horn of the ventricle is opened. At the close of operation it is best to close the ventricle loosely with a few silk sutures placed in the ependyma or passed from ependyma to tentorium.*

silk. A drain is placed in the extradural space and brought out through a burr-hole in the bone and a ' stab ' opening in the scalp placed a little way from the incision. The bone-flap is fastened with tantalum wire and the anterior burr-hole is covered with a small tantalum disk.

6. SUMMARY OF CLINICAL RESULTS

In the outset it must be recognized that medical therapy must always be given first place. Surgery is to be considered only after this has obviously failed to provide a reasonably satisfactory life for the patient.

Some general observations may be made as to the result of temporal lobectomy. When the line of removal is less than 6 cm. posterior to the tip, it is apt to result in no post-operative visual field defect. If the removal includes 6 cm. and more, it is apt to produce contralateral upper quadrantic homonymous hemianopia. When the line is pushed back to 8 cm., there is apt to be a complete homonymous hemianopic defect.

No other objective changes are to be expected as the result of temporal lobe removal, provided there is no injury to middle cerebral vessels. It is sometimes necessary to remove the cortex of the insula or to pass across the fissure of Sylvius and thus excise abnormal tissue there which is obviously capable of continuing the epileptogenic discharge.

* Closure of the ventricle will prevent or decrease the duration of post-operative ' aseptic meningitis '.

This must be done with greatest caution, using the sucker for grey matter only. Without these precautions the internal capsule may be injured or the middle cerebral artery caused to thrombose.

Behaviour abnormalities seem to be more frequent and more severe among temporal lobe epileptics than in other groups. Improvement does seem to follow cessation of seizures, provided no major psychosis has developed.

Progressive failure of memory is a frequent complaint among patients of this group without operation. After operation mild difficulty with recent memory is not uncommon. But in two patients severe loss of capacity for recent memory followed temporal lobectomy.* It now seems likely that there were lesions of both temporal lobes in these two cases, probably due to incisural herniation and sclerosis on both sides.

Our present conclusion is that when there is electrographic evidence of abnormality in both temporal lobes, radical removal of the uncal and hippocampal area on one side may well produce a defect in memory recording. Evidence of bilateral temporal abnormality should be considered a contra-indication to operation.

Analysis of operative results can only be carried out at long intervals. With my associate, Dr. Herman Flanigin, all cases of temporal lobe operation for cure of epilepsy during a 10-year period ending April, 1949, were reviewed (Penfield and Flanigin, 1950). There were 68 patients, with 1 operative death, a case mortality of 1·5 per cent. In 7 cases no objective abnormality was found at operation and no excision carried out. None of the 7 was claimed as a successful result. Fifty-five patients had stationary or atrophic lesions, and an excision was carried out. Fifty-one of these patients were followed from 1 to 10 years after operation.

In 25·4 per cent the result was considered ' worth while ' by the patient and operator. In an additional 52·9 per cent the result was considered a success. In this success group, 14 patients (27·4 per cent) had had no attacks and 13 (25·4 per cent) had one or more attacks before apparent cessation. These patients have had no anticonvulsive medication other than phenobarbitone. Most have reduced the dose or stopped it altogether.

Since that time our interest in and understanding of these cases has increased, with the result that 155 patients have been operated upon for temporal lobe epilepsy in the past four years. During that period only 121 were operated upon for focal lesions elsewhere in the brain. No further follow-up analysis has been made of the temporal lobe epileptics.*

CONCLUSION

Temporal lobe epilepsy, sometimes called psychomotor, is comparatively common, both in childhood and in adult life. The symptomatology is easily recognized. In the study of this condition it has become apparent that each temporal lobe plays an important role in certain mechanisms of memory and of perceptual judgement, but one normal temporal lobe can do the work of both in regard to these mechanisms.

The pathological change responsible for these seizures is most often incisural sclerosis, which seems to be due to brain compression at birth.

When such patients do not respond in a satisfactory manner to the best medical therapy, and when the temporal lesion is unilateral, partial temporal lobectomy offers what seems to be a 50 per cent chance of cure and a 25 per cent promise of improvement with comparatively little risk of life.

If the neurosurgeon is to succeed in this field he must learn to localize the epileptogenic lesion before operation. He must find a true abnormality of grey matter. During ablation he must respect the circulation and the integrity of the convolutions which are left behind.

Second possibly only to the relief of pain, I predict that the relief of focal cerebral seizures will some day constitute the most important therapeutic field in the surgery of the nervous system.

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* This is a subject of concern which has been studied by my associates, Dr. Brenda Milner by psychological methods, and Dr. Herbert Jasper from the electroencephalographic point of view. Further reports will be made of these studies at a later time and psychiatric analysis of the behaviour of those patients will be added then by Dr. Karagulla.

* Mr. Kenneth Paine has reviewed the results of operative treatment of atrophic cortical lesions in all locations (Penfield and Paine, 1953). This covers the six-year period ending in 1950, 234 patients. In that analysis 20 per cent of the follow-up results were rated as reasonably satisfactory and 45 per cent as successful from the point of view of arrest of seizures.

SURGICAL LEADERSHIP*

IN MEMORY OF ARBUTHNOT LANE

By Sir HENEAGE OGILVIE, London

Surgery is hand work. It deals for the most part with processes that are localized—localized in space and localized in time. Being localized in the body, they can be mended or removed by the surgeon's skill. Being localized in time, they can be mended effectively only if the application of that skill is timely. Surgery deals with some crisis, great or small, in the lives of people hitherto healthy and active, and if the treatment is effective it restores them to health and activity. The effectiveness of the treatment depends on the services of one man—the surgeon—on his correct assessment, his timely decision, his skilful manipulation, and his unremitting care.

The yes-man, so far from being a figure of fun and an object of derision, is an essential part of every co-operative enterprise, for the yes-man is one who carries out orders promptly, efficiently, and without argument. The yes-man is needed in government, for the prime minister can carry on the business of the country only if he is the head of a group who are prepared to implement the policy of the party that he leads, however much they may differ from him or even oppose him in private. The yes-man is needed in business, for the heads of departments, whatever their personal views, must be loyal to the managing director as they expect their subordinates to be loyal to them. He is above all needed in research, for the vision of a Fleming is finally transmitted into the penicillin that is sold in bottles and injected into buttocks by the work of thousands of yes-men B.Sc.s working with the specialized but unintelligent industry of ants at some detail of the structural formula. The yes-man becomes despicable only when his yes-manship is assumed for personal advantage.

The surgeon must be no yes-man. He can neither take orders, nor can he share responsibility. He is not a tradesman supplying packaged goods to customers, but a craftsman, hiring out his services to a client who cannot specify the job that he wants done, other than that it must be well done. His decisions must be his own, and they must be firm decisions. Every surgeon must be a leader as far as his own work is concerned. Decision to him is what diagnosis is to the physician and investigation to the pathologist. On the job he is as responsible and as lonely as the captain of a liner. Who then can be captain of the captains? Who then can be a leader among surgeons? Who have been surgical leaders?

We must distinguish between invention and leadership, between the ability to bring new ideas to surgery, and the power to inspire disciples and found a school. The invention of a new method or a new instrument is a sure way to fictitious immortality, but not to leadership. Students to-day, dressing a suprapubic fistula, attending a lecture, or reading a prize essay, ask "Who was Hamilton Irving, who was William Wood Bradshaw, who was Samuel Jackson?"—and they may well ask. But they do not, or should not ask, "Who was Spencer Wells, who was Kocher, who was Moynihan?", for these men did something besides invent forceps.

What qualities make a man a leader among leaders, one whom free men will call Master? Certainly not the qualities of a Führer or a Duce, the strident voice, the jutting chin, the gestures of command, the shouted slogans demanding the answering chorus of approval. A leading surgeon does not claim leadership; it is offered to him and he accepts it, often without knowing or seeming to know that it has been offered or accepted, because of certain qualities which I will try to define.

First, he must be superlatively good at the technique of surgery, so that men who are craftsmen themselves acknowledge him as a master-craftsman.

Secondly, he must be fertile in ideas, able to find or suggest the answer to problems and to frame new problems that his solutions bring forward. He must be one to whom men turn for advice and enlightenment, whose words, while they may not bring light at the time, glow in the memory till light springs from them.

Thirdly, he must be able to communicate his ideas, not necessarily to the many by speaking and writing, but in personal contact; for it is in fireside conversations with friends, in the attempt to put into words ideas still unformulated, rather than in prepared addresses, that men tell us what is in their hearts.

Fourthly, he must have the courage to fight or to ignore opposition, to go on undeterred by blame and uninfluenced by flattery, on the path he believes to be right.

Fifthly, he must be humble, never seeking position, but allowing others to award it to him, never claiming priority for a method but merely saying that is the way he does it.

And *lastly*, his enthusiasm must burn with a quiet flame that warms all who come into contact with him.

There are great surgeons of the past who will not stand up to all these tests of leadership. Joseph Lister was a great man by any standards. He was a prophet but not a leader. By his work he was responsible for saving more lives than have been lost in all the wars of history. He had genius, he had enthusiasm, he had courage, he had the power of clear expression. But he was a poor operator, and took no part in the immense technical advances that his discoveries made possible, and in his later years he was railing against those who presumed to modify his methods. He had adoring pupils, but they were shadows rather than disciples, and none of them had the stature to step into his shoes. The discovery of the cause of sepsis was inevitable.

* Presidential Lecture to the Section of Surgery, Royal Society of Medicine, October, 1953.

It was made possible by the invention of the compound microscope. It was heralded by Pasteur's researches on putrefaction. Many men were on the trail. But Lister's dogged persistence and his courage in the face of calumny, brought it to surgery perhaps some ten or twenty years sooner than it would otherwise have come.

William MacEwan was in many ways a greater man than Lister. He was a little behind him in the introduction of asepsis, but he worked in the whole field of surgery and made fresh discoveries while Lister was content to tinker with his first one. He was a founder of neurosurgery, thoracic surgery, vascular surgery, otology, and orthopædics. He was a giant among men ; but unfortunately no one was more aware of the fact than he, at any rate in his later years. He might well have said, " Why man, I do bestride the narrow world like a Colossus, and you petty men walk under my huge legs, and peep about to find yourselves dishonourable graves ". Not merely had he no colleagues and pupils ; he would tolerate no possible rivals near the presence, and he left Glasgow surgery a desert which has only lately been made to blossom by the brilliant group who work there to-day.

Nearer our time we have in Moynihan the example of a great man who lacked the great gift of humility and whose reputation has in consequence suffered more than it deserves. It is early as yet to assess the value of Moynihan's personal contributions to surgical science, but as an operator he possessed a technical skill that has seldom been equalled, and as a master of English prose he set a standard in writing and in oratory that has never been surpassed. He did more for the unification of British surgery than any other man. He was the prime mover in the foundation of the BRITISH JOURNAL OF SURGERY and the Association of Surgeons, and the Travelling Surgical Club that is now named after him was the forerunner of many similar groups that travel round the world in company and bring back with them new ideas. But admiration turned his head and in the end he was his own greatest admirer, and estranged the young men who should have been his followers. There are many to-day who use what they proudly call Moynihan technique, but few who call themselves Moynihan's men.

Three men come to mind who, whatever their stature in the surgical world at large, were worshipped by all who came under their spell, who stamped their personality on generations of House Surgeons and dressers, and who are spoken of to-day with deep affection by men who have become leaders in their turn and have taken their surgical creed to all parts of the world. Such men were Rutherford Morison, Robert Jones, and Arbuthnot Lane. I shall speak of the last because I worshipped him from the day I arrived at Guy's and I worship his memory to-day. He had to a unique degree that great gift of inspiring devotion which is true leadership.

There has never been a man more difficult to assess than Lane. To-day there are those who would rate him a little lower than the angels, and those who regard him as a successful fake. In his time some, best qualified to judge, looked on him as the greatest surgeon in the world ; some, including many of his colleagues, could find no abuse strong enough to heap on him, and made a point of attending every meeting at which he was due to speak in order to howl him down. What is not sufficiently realized is the effect this hostility had on Lane himself, on his manners and his mannerisms, on the face he put before the world. He knew his own worth. He knew that he could bring to a successful issue operations that in the hands of any other surgeon of his time would be fatal. He knew that he had more ideas than he would ever be able to carry out. But he kept his enthusiasms and his triumphs for his friends and pupils, and particularly for his House Surgeons and Registrars. To them alone he granted at times a glimpse of the proud, shy soul smarting under attack. He avoided meetings and discussions, and when he spoke he stated his case dogmatically, even arrogantly, and refused to be led into argument or explanation. He had a favourite phrase—" It's all so simple, really ". When his old friend, Hale White, led the attack on him at a discussion of the Royal Society of Medicine, Lane made no public reply, but said to him in his gentle voice as they left the room together, " I'm sorry, Hale White ; I'm afraid I shall never be able to convince you ".

Yet Lane was the greatest surgical figure of his generation. He was the builder of the new surgery with the bricks that had been made but dumped down unused by Lister. He was the founder of modern orthopædics as distinct from the traditional craft of the bone-setter. He proposed, founded, staffed, and constantly encouraged the first centre for plastic surgery in the world, at Sidcup in 1916, and may be regarded as the father of modern plastic surgery. He developed a technique that was dazzling in its brilliance, and, in the opinion of men like Charles Fagge and George Waugh, who were able to judge, better than that of any surgeon operating in the first twenty years of the present century. He attracted visitors from every country in the world, and his theatre was always filled to capacity. His reputation was such that his pupils stepped into surgical appointments wherever they went almost as a matter of course. I had not the fortune to secure the appointment of House Surgeon to Lane, and merely held the post as locum tenens for six weeks. Yet even this temporary clutch at the hem of his garments secured for me the offer to go as third surgeon to the Urgency Cases Hospital, then being equipped by the French Red Cross to work behind the 2nd French Army in the Argonne, and the grade of Surgical Specialist when later I transferred to the R.A.M.C.

William Arbuthnot Lane was born in 1856. He was the son of Benjamin Lane, an Irishman in the Army Medical Service, who retired in 1882 with the rank of Brigade Surgeon. As a child William travelled with his family in many countries, and received his schooling in Malta, Nova Scotia, and Scotland. In 1873, at the age of sixteen, he was entered as a student at Guy's, chiefly because his father was then stationed at Woolwich. He qualified at the Colleges in 1877, and then went back to take the M.B., B.S. of London University. He took the Mastership in Surgery of London University in 1883, and the Fellowship of the Royal College of Surgeons in 1884. He was appointed Assistant Surgeon to the Hospital for Sick Children, Great Ormond

Street, in 1886, and to Guy's Hospital in 1887. He became full Surgeon in 1903. In 1913 he was created a baronet. He should have retired in 1916, but stayed on at Guy's till the end of the First World War. He died in 1943 at the age of eighty-seven.

In accordance with Guy's tradition, Lane held the post of Demonstrator of Anatomy between working as House Physician and his appointment to the staff in 1887. During this time he re-edited Carrington's *Anatomy*, but his most important work was his research into the structure of the skeleton, and its reaction to the stresses to which it is subjected. He dissected the bones and ligaments of thirty-five men and women drawn from the labouring classes of South London, and found that the structure of the bony framework of the body corresponds to the direction through which the forces applied to it are transmitted to the ground, or from the shoulder girdle to the hand. He summarized his conclusions by saying that " the skeleton represents the crystallization of lines of force ". In this phrase the young surgeon, not yet in charge of patients, enunciates for the first time a principle in the physiology of bones and joints that has since been universally accepted, and has received detailed confirmation since radiography has allowed us to study the internal structure of bone. At the same time, that is in 1885, he was discussing with his contemporaries the possibility of removing a lung, and said it could be done ; half a century was to pass before advances in anæsthesia made this operation possible for his successors.

While working as House Surgeon at Tite Street, and later as Assistant Surgeon at Great Ormond Street, he established the principle of rib resection in the treatment of empyema thoracis. He studied the infections of the middle ear, and its spread through venous channels. He described the mastoid antrum, its functions and its relations, and replaced the operation of simple trephining for mastoid suppuration by wide resection of the overlying bone and air cells, for which he devised special chisels and gouges. In one case he drained a large temporosphenoidal abscess secondary to middle-ear suppuration, an operation never before attempted. He introduced the operation of ligature of the internal jugular vein, to prevent the spread of a septic clot from a thrombosed lateral sinus into the general circulation. At the time when death from septicæmia was a not uncommon sequel of middle-ear disease this was life saving. In one instance, after removing the whole internal jugular vein down to its junction with the subclavian, he found that the clot, which contained pus in its centre, extended into the innominate vein. After removing it, he found on measurement that it had extended through the superior vena cava into the right auricle of the heart. The patient, who was a nephew of Lord Nelson, survived to be killed in the First World War. He modified and improved Davies Colley's flap operation for cleft palate, and paved the way for the modern operation by showing that even a large gap could be closed securely by surgical means.

At about this time he made two innovations, the one unsuccessful, the other a precursor of modern treatment. He experimented with the use of hetero grafts of bone, transplanting a piece of rabbit's bone to fill a gap in the radius, and putting a sheep's elbow-joint into a patient. In each case the technique was faultless, but the graft failed, for reasons that were not then understood. In 1890 he infused normal saline into the vein of a girl dying of shock and saved her life. Saline transfusion had been tried in animal experiments by Lane's colleague, Dr. Woodridge, but it had not, as far as was known, been applied therapeutically to human beings. He discussed the surgical treatment of mitral stenosis, and tried unsuccessfully to persuade his medical colleagues to allow him to attempt the operation. He sought fresh ideas wherever he went. After his first visit to America in 1906 he returned with a number of methods new to London ; in the theatre the use of caps and masks, and of open ether on a mask for anæsthesia ; in the wards a Murphy rectal drip and the Fowler position.

His maturity was notable for three main campaigns : his advocacy of the operative treatment of fractures, his belief in intestinal stasis as a cause of disease and his advocacy of its treatment first by colectomy and later by liquid paraffin, and his replacement in operative surgery of antisepsis by strict aseptic methods and his development of the no-touch technique. These policies of Lane's are so important in the history of surgery, and in the assessment of Lane as a man in relation to the intellectual atmosphere in which he lived, that I must deal with them more fully.

The second half of the nineteenth century was in many ways unique in the world's history. Till then, and since then, the progress of human thought and economy has been continuous, moving sometimes in jerks, latterly with ever-increasing acceleration, but each step forward being in some way based on what went before. The iron age provided better tools and weapons, but bearing a general resemblance to those of the stone age. Christianity embodied many of the myths and all that was best in the teaching of the old pagan religions. But the Victorians had to face two revolutions in thought that upset completely their basic beliefs, and their conception of the nature of the world they lived in. The first was the Darwinian theory of evolution that showed them a universe of infinite antiquity, peopled by creatures arising from a common stock of which man was one, and differentiating in response to certain needs and certain opportunities, rather than a world created suddenly by divine fiat in which birds, beasts, fishes, and creeping things each had its allotted place in a heirarchy ruled by man, himself created in God's image. The second was the discovery of bacteria, an order of beings infinitely more minute and infinitely more numerous than the species known before, present everywhere, in the air, the soil, and the sea, and able to cause disease and death.

Lane belonged to the first generation that accepted these discoveries as facts rather than as interesting theories. He believed in them with the passionate zeal of a convert. He believed in evolution, but he looked on it as a force acting within a measurable time rather than over periods reckoned in hundreds of millions of years. He believed in bacteria and knew their power, but he thought, as indeed did Lister, that they were all evil, and did not realize

that the great majority were workers essential to maintaining the cycle of life.

In his early days in the dissecting room we see Lane, the evolutionist, seeking the causes that have moulded man's structure. Among the skeletons of the thirty-five bodies he dissected, nine showed changes that he considered were the result of occupational stresses, and in three of these at any rate he was able to show that the man's occupation had indeed been the one he suspected. One man, whose spine showed an unusual range of rotation, was stated in the records to have been a ' trimmer ', and Lane went down a ship's hold to watch a trimmer at work distributing the coal as it shot down into the bunkers and swinging his body as he did so. Oliver Wendell Holmes wrote to congratulate him on a fine piece of detective work.

Lane's interest in the skeleton of the labourer inevitably drew him to the treatment of fractures when he came to have his own beds at Guy's. Fractures were then treated by the senior surgeon, and referred after discharge to the assistant surgeon, whose job it was to tell the man that the fracture was united and he could go back to work. Firm union was the criterion of success. If there was non-union or fibrous union the fault lay with the patient, with some defect in his blood or with his inability to keep the splints adjusted. If there was bony union the result was a success, and any error of alinement was an æsthetic question affecting the surgeon's reputation rather than the patient's ability to use the limb. To Lane fell the thankless task of explaining away the results of traditional treatment. " Mr. Lucas says this leg is a good result ", pleaded the docker, " but I can't work with it. My job is to carry a sack weighing 2 cwt. along a plank from a barge to a wharf, and I can't do it. The foreman won't have me and I am still out of work." " Out of work " to a docker meant that he was on Poor Relief and that his wife and family were in the workhouse.

Lane went down to see the dockers at work. He watched them tramping in line along a plank, each bearing a 2-cwt. sack of flour on his bent back. A slip would mean a fall between the dock and the barge side, and a man with the slightest valgus deformity might easily make that slip with the load he was carrying. Lane brought to the problem of the unfortunate docker, transferred by an accident from gainful work to casual labour or unemployment, a mind already prepared by the study of the skeletal anatomy of those who worked with their hands and carried great weights on their backs. He brought a new approach to fractures, an approach that considered not merely the break in the bone but the joints above and below the break. If the relationship of these joints to each other were disturbed as a result of the position in which the fracture had united, a new crystallization of the lines of force in the bones of the limb would take place, and the joints would also suffer new stresses, and would undergo changes similar to those seen in old age. He concluded that if a broken bone is to do as good work as it has done before, its parts must be put back exactly into the position they held before the accident. Then, when union was firm the restored bone would be as good as it was before, the lines of force would pass along it as they had done, and they would cross the joints above and below the fracture from the same place on one surface to the same place on the other. In that way, and in that way alone, would the limb be as good as it was before, and the individual be able to do with it anything that could be done previously.

This was the doctrine that Lane taught. It was new, it was revolutionary, it was successful, and it changed the whole face of fracture treatment. His aim was the restoration of perfect function by the restoration of perfect position. He found that he could not attain this aim except by open operation. He was a master craftsman and he designed exact tools to do his work. His bone holders, bone levers, plates, plate benders, plate holders, screws and screw holders have been modified by many in the half-century since he introduced them, but always to their detriment. His screws particularly, wood screws with the thread continued up to the head, take account of the fact that bone has the strength of hard wood, about a tenth of that of steel, and that therefore the groove between the threads must be about ten times as broad as the thread itself. Sherman's screws, which treat bone as if it were metal, can be pulled out with a fraction of the force necessary to displace a Lane screw. But the exact method of fixation was to Lane entirely secondary. His object was to put the broken pieces exactly where they were before, and, having replaced them, to keep them there. An external splint could not do this because it did not keep the limb sufficiently still; therefore he used an internal splint applied direct to the bone. He always spoke of his plates as internal splints and never thought of them as anything else.

It is difficult to-day to appreciate the dreadful state of fracture treatment when Lane came on the scene, or to understand the execration with which his proposals were received. The difference between a simple and a compound fracture, words that have little meaning now, was to the surgeon of the late nineteenth century, the difference between an accident that, properly treated, would give a useful limb, and a disaster that usually ended in amputation or in death. One of Lister's greatest achievements was to show that a compound fracture could be made to heal and unite. But to Lister's contemporaries and pupils the wilful conversion of a simple fracture into a compound one was little less than a crime. The President of the Royal College of Surgeons stated at a public meeting that a man who made a simple into a compound fracture was guilty of mal-practice and should be struck off the Register. The Regius Professor of Surgery at Cambridge said the same. The G.M.C. held a meeting to consider whether any action should be taken against Lane. Had he failed they would most certainly have done so. But he did not fail.

Lane succeeded by devising an aseptic technique that was faultless—faultless from the beginning. With him there was no stage of trial and error. There were no failures. His no-touch technique set a standard that has not often been reached by others and never excelled. I do not believe that Lane ever had a failure. I know that some of his plates have had to be removed years later, but, in a

considerable experience, I have never seen any trouble in a case operated on by Lane himself. On the other hand, his operative methods in the hands of surgeons who did not trouble to learn his technique, or to follow it in all its detail, were by no means successful. Many will remember the lamentable exhibition of the results of the operative treatment of fractures shown at the Association of Surgeons' meeting in Glasgow in 1927.

The criticism of his fellows—bitter, blind, uncompromising—told upon Lane's health. He retired more than ever into his shell. He lay awake at night wondering whether any of his cases had gone wrong. They never did. In response to public clamour the B.M.A. appointed a committee to inquire into the results of fracture treatment. The report, published in December, 1912, was a triumphant vindication of Lane. Three of the conclusions may be quoted :—

" vi. In nearly all age groups, operative cases show a higher percentage of good results than non-operative cases."

" vii. Although the functional result may be good with an indifferent anatomical result, the most certain way to obtain a good functional result is to secure a good anatomical result."

" x. It is necessary to insist that the operative treatment of fractures requires special skill and experience, and such facilities and surroundings as will ensure asepsis. It is therefore not a method to be undertaken except by those who have constant practice and experience in such surgical procedures."

To many men of the present generation Lane is remembered as the man who removed colons, and remembered only with amusement or pity. Had he not followed the will-'o-the-wisp of intestinal stasis with the single-minded enthusiasm that was one of his main characteristics, his reputation would stand to-day much higher than it does. The period when he believed colectomy to be the panacea for all ills was a comparatively short one, from about 1910 to 1916, but it came towards the end of his active period, and it tended to efface the memory of his enduring work in every branch of surgery. During this time he was as one hypnotized. He removed colons for the treatment of such diverse conditions as tuberculosis, thyrotoxic goitre, and peptic ulceration. His diagnosis, inspired in everything else, became a matter of leading questions followed by a perfunctory examination, his reports of results were case-histories of patients whose main desire was to say what would please the man they adored. His House Surgeons saw everything through his eyes and shielded him from criticism.

But it is as foolish to laugh at Lane for this as to decry him. He was no crack-brained faddist. He was the leader along a path that all his contemporaries were exploring timidly. To understand his line of thought we must remember the views of the first ardent evolutionists, the first germ theorists. Lane believed that circumstances were modifying the structure of the human frame as he wrote. He found in changes in the skeleton evidence of the efforts of nature to meet the stresses imposed by industry. He found in the various peritoneal bands that anchor the large intestine, evidence that she was attempting to adjust the alimentary tract to the needs of a recently assumed upright posture. He believed that organs were in contemporary process of being altered or eliminated, and that useless organs might remain after their function had gone. He believed that germs were an evil order of creation, the enemies of mankind and particularly of the surgeon. He came to look on the large intestine as an unnecessary survival of an age when man's ancestors had lived under different circumstances and eaten different food, a dangerous survival because it swarmed with germs.

In these beliefs Lane merely stated more emphatically what everyone else believed. The colon contained millions of germs, germs were evil, therefore the colon was evil. In 1902 Barclay Smith, of Cambridge, wrote : " I am convinced that the large intestine is practically a useless encumbrance to man ". In 1903 Metchnikoff wrote : " It is no longer rash to say that not only the rudimentary appendix and the cæcum, but the whole of the large intestine are superfluous, and that their removal would be attended with happy results ". In 1912 Arthur Keith wrote : " It is very apparent that Mr. Lane's pioneer operative measures are finding every year an increasingly wide application and that the views of Metchnikoff and of Barclay Smith are gaining in acceptance among medical men ".

Lane was a pioneer. In performing colectomies he was doing what any other surgeon of his time would have done had he had Lane's courage to propose the operation and Lane's skill to perform it successfully. Instead they relied on purges, on intestinal antiseptics such as creosote, on repeated wash-outs before any operation on the abdomen and on half-hourly doses of calomel afterwards. Nor were Lane's results with colectomy all unhappy. Within the last year I have been consulted about some minor ailment by an old lady who sang his praises as loudly as I am doing to-night and who assured me that she had been a hopeless invalid till he removed her colon forty years ago.

I must deal briefly with Lane's technique, for every operating theatre in every country has been in some way influenced by it. Lister published his first paper in 1867 and moved from Glasgow to Edinburgh in 1869. Henry Howse adopted the antiseptic method when he was appointed to Guy's in 1870, and his colleagues followed suit, operating under the carbolic spray in old frock coats kept for the purpose Thus Lane never knew the pre-antiseptic days, but was brought up a Listerian. He soon abandoned the spray. He and all his firm wore long macintoshes, over which were gowns soaked in lysol, and used instruments sterilized in carbolic. Later the gowns were first boiled and then transferred to lysol and the instruments were boiled. At the beginning of the century he was using gowns, towels, and dressings sterilized in steam and had abandoned the use of antiseptics in the wound. He changed completely before washing up. Rubber gloves followed in 1902.

When he made the revolutionary proposal to treat closed fractures by operation he knew that he would be bitterly opposed, and, if any cases became infected, he would be persecuted without mercy. To avoid any chance of infection he elaborated his no-touch technique. He designed instruments 8 in.

long, 4 in. for the hands and 4 in. to separate the hands from the tissues. He handled the tissues with instruments, he tied ligatures with instruments, he threaded needles with instruments, and he tied sutures with instruments. During the operation he sent to be reboiled any instrument that had touched hands, skin, or towels. He was the first surgeon to use skin towels fastened to the edges of the wound. With him sepsis was unthinkable and sepsis did not occur.

But apart altogether from surgical technique in the strict sense, Lane was probably the best operator of his time, possibly of all time. A surgeon who knew him at his best writes: "For a long time, for a patient to have his abdomen opened by Lane gave him a greater chance of life than if it had been done by anyone else, with very few exceptions. This was in part the development of his technique, but not all. Primarily it was the delicacy of his hands. He did not have to practise being gentle, his hands were so by nature." Another writes: "Lane was the most perfect surgical workman I ever watched. I do not refer to his no-touch technique, nor am I thinking of the set of long-handled instruments he invented to facilitate it, but when Lane was operating, no matter how difficult the operation, in his hands it appeared easy. No haste and no violence, but long easy strokes of the knife guided by profound anatomical knowledge, every stroke purposive, and the stage of sewing up soon arrived at."

Lane was a pioneer and an explorer, but he never claimed priority for anything he did, nor was he interested in priority. He was constantly seeking to do better work and therefore he was constantly changing his views and his methods. He did a thing, and did it for the first time, but if he heard later that someone else had had the same idea he was interested merely because it supported his belief that he had done right. Lane's admirers, on the other hand, have credited him with priority in a number of enterprises, often wrongly. It has been said that:—

1. He was the first man to use metal plates in fractures. That is true, but it was only an extension of Lister's enterprise in wiring the patella. But whereas Lister used wire as an occasional expedient, Lane established a principle.

2. He was the first to perform the radical mastoid operation. Lane's operation for mastoid suppuration was not the modern radical operation, but it was far more radical than the simple drainage that had preceded it, and an important landmark in the history of the treatment of middle-ear disease.

3. He was the first to tie the internal jugular for lateral sinus thrombosis. This is true.

4. He was the first to take out a rib for empyema. This is inaccurate. Several other surgeons had done it before him; but whereas the others used rib resection as an occasional expedient, Lane established it as a principle.

5. He was the first to massage the heart after cardiac arrest through an abdominal incision, and restore its function. This is true. The case is recorded in *The Lancet*.

6. He was the first to introduce saline into the circulation. Latta had done the same in 1832, but the method had been forgotten for sixty years.

7. He was the first to describe the clinical picture of intestinal toxæmia. Many will not look on this contribution as an advance; yet Lane, in overstressing the importance of alimentary toxæmia, was probably nearer the truth than those who to-day deny its existence.

8. He was the first to discuss pneumonectomy and the operative treatment of mitral stenosis. This is also true, but many years were to pass before his vision became a reality.

He left his mark, the mark of a trail-blazer, wherever he went. In 1890 he removed a stone from the lower end of the ureter through an abdominal approach, having made the diagnosis before the advent of X rays or cystoscopy. His divided purse-string suture, unpublished, for he never wrote of technique, only of principles, remains the best way to invaginate the appendicular or the duodenal stump.

It remains to attempt some assessment of Lane, the man. In doing so I must let others speak. "William Arbuthnot Lane", writes an old House Surgeon, now a leading surgeon himself, "was one of those men who sets classification at defiance. He was a lion among men, a king among surgeons, a wizard who seemed to arrive at correct conclusions without consecutive processes of thought, a magician who with the touch of his hand could compel a patient to get well, or with a quiet spoken phrase could free an ageing woman from the thrall of brandy, a thinker who in consecutive moments could rank among the greatest logicians—or the most illogical. A dreamer who could rouse to the height of enthusiasm those who felt he was right and drive to the depths of abuse those who thought he was wrong. A great-hearted man with a profound sympathy for all mankind. Few of those who worked with him during his rise to fame in the last years of the nineteenth century are left, and they are old. Even we who were with him in the first decade of the twentieth century are getting on. Yet it is from the words of those who knew him that we must build up his life."

Blundell Bankart writes: "To work with him was an inspiration, and he had a most profound and lasting influence on all who were associated with him. He was a man to learn from and not one to be taught by."

That phrase sums him up. "He was a man to learn from and not one to be taught by." He must have been a trial to his colleagues. He never indulged in clinical teaching in the accepted sense. He never discussed orthodox pathology, or demonstrated physical signs. He was an inspired diagnostician, but he could not communicate his skill to his pupils. He made his diagnosis by a process of "laying on of hands", by a sense of tactual perception that he had learned by long training, and that had become so highly developed that it gave the answer without passing through the stage of conscious thought, certainly without recording the reasoning by which the answer was reached. Beddard, one of the ablest physicians of his time, remarked: "How that man Lane has the nerve to come in and make a diagnosis just by putting his hand on the abdomen I don't

know, but, by God, he's right". A surgical colleague said: "If I have made a diagnosis different from Lane I know I am wrong". He gave clinical lectures, as he was bound to do, but they were merely recitals of his views on the skeleton, on fractures, on bands and kinks in the abdomen, on intestinal stasis, and they were useless to students. His essential teaching was imparted to his students, and particularly to his House Surgeons and Registrars, in casual remarks while operating, in sudden outbursts of enthusiasm as they went together down the colonnade, particularly in revealing comments on the orthodox teaching of the day that might have sounded unkind were it not for the gentle smile that accompanied them, and that forced the hearer to go back and think again. He was inconsequential, he was inconsistent, he was most in earnest when he seemed to be jesting, but he had the divine gift of making all who penetrated the veil of his reserve to feel that they "on honeydew had fed and drunk the milk of Paradise".

It is interesting to speculate on the sort of man Lane might have been had he had a fair deal. Probably very much the same. But almost from the outset he was surrounded by hostility. His seniors, not alone at Guy's but everywhere in London, disapproved of him with a bitter hostility that sought every opportunity to attack him.

Part of this opposition was the instinct of the herd to attack any creature who does not conform to pack law. He was an Irishman and he spoke in the poetic imagery of the Celt rather than in the pompous periods of the professors to which professional London was accustomed. He loved to let off squibs in the holy of holies, as when as a young man he informed a meeting of senior otologists that the removal of tonsils and adenoids was unscientific and should be abandoned. But much of the opposition was due to envy, hatred, and malice, and nothing else. He spoke freely and forcibly at a time when it was an accepted maxim that "assistant surgeons should be seen and not heard". He thought for himself when reverence for authority was considered to be the beginning of wisdom, and he was usually right. He flouted conventional teaching and he got away with it; the students having listened to a diatribe against him, went to see what manner of man he was, and they came back converted. He was superlatively good at his work and he was phenomenally successful in his practice. The greybeards felt their thrones trembling under them; like the wicked husbandman, they exclaimed: "Here is the heir, come let us kill him".

One who was his House Surgeon, his Registrar, and later his colleague, recalls the conversations he held with Lane on the subject of fractures: "He told me all this at intervals during the early spring as we were walking across the park at Guy's, or driving in his carriage on the way to Cavendish Square, or sitting in his consulting room taking tea. I can hear him saying it in a voice from which all the weariness was removed, the weariness that usually was in it from the abuse that persistently was thrown at him by his contemporaries for everything he did. When telling me this his voice had a happiness in it that was not often there. By then he must have learned that it was by his juniors that his work would be recognized if ever it was to be recognized at all; and he was speaking to a junior, telling him of what had passed through his mind fifteen and more years before."

Arbuthnot Lane was one of those kaleidoscopic personalities whom the observer can see only in one colour. I see him in the golden light of my own surgical forenoon, but I realize full well that to his contemporaries he must have been a difficult man to work with. He knew no half measures. He pursued the interest of the moment with an enthusiasm that saw everything, even diagnosis and results, in the light of his beliefs at the time. He never entered into discussions; indeed, there were few men whom he treated as equals. He ignored his contemporaries or was rude to them. He spoke of Lister and Paget as bad surgeons, as indeed they were to one who set high store on technical ability. He seldom praised. He seldom acknowledged the work, or even seemed to recognize the existence, of his juniors.

I cannot, however, find a more fitting conclusion than the words of one of them. He says: "An attempt to draw a picture of Lane gives the impression of a man a bit of a charlatan, or at any rate slightly cracked. Yet he was a giant among surgeons, possibly the greatest influence for good since surgery began, because he lived in that period when surgery had its greatest opportunities. But what he did is almost impossible to define. It was entirely personal. He led, he inspired, he brought up generations of people who were proud to call themselves Lane's men. All over Britain and the British Empire to-day there are men who stand in the direct Lane tradition, and who in turn have handed on the Lane spirit through a second and third generation."

THE ADEQUACY OF THE MARGINAL BLOOD-SUPPLY TO THE LEFT COLON AFTER HIGH LIGATION OF THE INFERIOR MESENTERIC ARTERY DURING EXCISION OF THE RECTUM

By J. C. GOLIGHER

FROM THE RESEARCH DEPARTMENT, ST. MARK'S HOSPITAL FOR DISEASES OF THE RECTUM AND COLON

ALL investigations into the mode of dissemination of rectal cancer are agreed in emphasizing the paramount importance of upward lymphatic extension along the superior hæmorrhoidal and inferior mesenteric vessels in the spread of this disease. In carrying out radical surgical treatment it is clearly necessary therefore to aim at as thorough a removal of these lymphatics as possible, and this in turn implies a high level of ligation and division of the inferior mesenteric vessels. It was this consideration more than any other that led to the abandonment of purely perineal and sacral methods of excision of rectal carcinoma and to the adoption of the combined abdomino-perineal excision of Miles and other techniques embodying an abdominal phase, for it is only through an abdominal approach that a really high ligature of the inferior mesenteric artery can be effected.

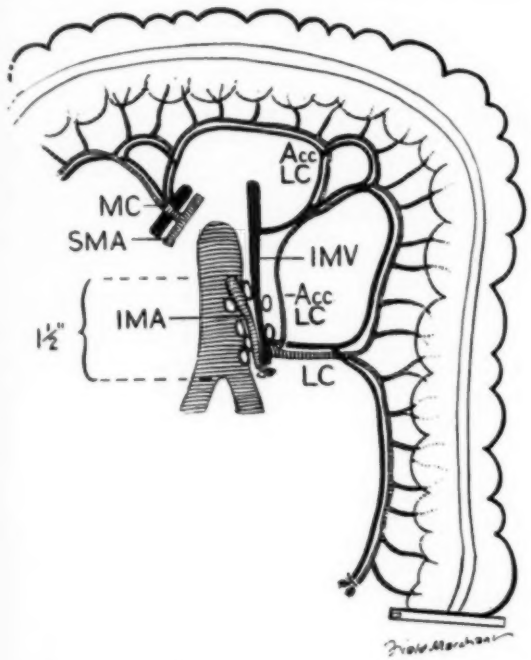

FIG. 421.—Site opposite the bifurcation of the abdominal aorta recommended by Miles for ligation and division of the inferior mesenteric artery (IMA) during abdomino-perineal excision of the rectum. Note short remaining segment of main artery with related lymph-glands, and left colic (LC) and accessory left colic (Acc. LC) branches arising above level of ligature.

Miles (1926) actually recommended that in the performance of his operation the main ligature should be placed opposite the bifurcation of the abdominal aorta. This tie usually lies just below the origin of the left colic, and sometimes also the first sigmoid artery, so that whilst it permitted of a high division of the inferior mesenteric vessels, it also generally ensured a good direct blood-supply to the portion of the colon selected for establishment of the colostomy (*Fig.* 421). However, the inferior mesenteric artery arises from the aorta some 1½ in. above this point, and this technique therefore leaves a small portion of vessel with related lymph-glands which might have been excised, making the operation slightly more radical. Recently Deddish (1950), State (1951), Ault, Castro, and Smith (1952), and Grinnell and Hiatt (1952) have recommended tying the inferior mesenteric artery at its origin from the abdominal aorta in order to avoid leaving this remnant of artery and associated lymphatics. From the pathological point of view this is an eminently logical extension of radical excision for rectal carcinoma, and Grinnell and Hiatt (1952) illustrate specimens in their paper showing involved lymph-glands at the upper end of the inferior mesenteric chain which were removed by high ligation but would undoubtedly have been left in situ if the vessels had been divided at the level of the aortic bifurcation. It must be admitted, however, that in cases with lymphatic metastases of this extent the prognosis is probably very poor anyway and may not be much influenced by this increase in the scope of operation, even if extended to include dissection of glands off the abdominal aorta, as suggested by Grinnell and

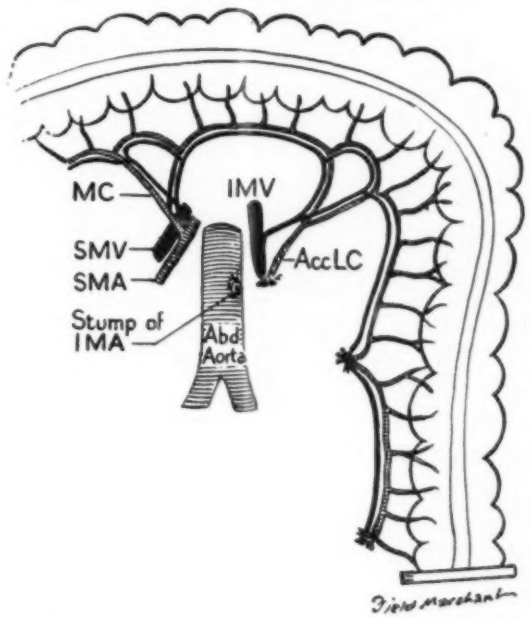

FIG. 422.—High ligation of the inferior mesenteric artery (IMA) at its origin from the abdominal aorta, leaving the descending and iliac colon supplied by the middle colic (MC) artery through the marginal artery.

Hiatt (1952). The precise value of higher ligation of the inferior mesenteric artery remains to be established by a long-term follow-up, but there is certainly a good theoretical basis for its trial.

An obvious consequence of ligation of the inferior mesenteric artery at its origin is that the left colic branch is sacrificed. This means that the only blood-supply remaining to the descending and iliac colon is that derived from the middle colic artery and conveyed by the marginal artery (*Fig.* 422). Most surgeons practising high ligation of the inferior mesenteric artery during rectal excision have taken the view that this supply would be adequate only for the survival of a limited amount of colon and have therefore recommended extending the resection almost up to the splenic flexure or into the transverse colon in order to diminish the amount of bowel nourished solely by the marginal vessels. An additional argument advanced by State (1951) for so doing is that the paracolic glands alongside the iliac and descending colon may contain metastases, and that their removal by extended colectomy may make the operation more radical. The work of Dukes (1930) on the spread of rectal cancer, however, shows that upward lymphatic extension is confined with remarkable consistency to the glands intimately related to the main superior hæmorrhoidal and inferior mesenteric vessels. Only in advanced, probably incurable, cases in which these glands have undergone extensive blockage by growth, do the paracolic glands become implicated. Dukes's work therefore supports the claim for higher ligation of the mesenteric vessels themselves, but offers no pathological rationale for extended resection of the colon and paracolic glands. The sole criterion for resecting the left colon after high inferior mesenteric ligation is the circulatory condition of this segment of gut after it has been deprived of its direct blood-supply through the left colic artery, or arteries, and the problem is whether this can ever be sufficiently good to maintain viability.

The classical study of the arrangement of the arteries to the colon by Steward and Rankin (1933) demonstrated that invariably there is a free communication between the middle colic and the left colic arteries through the marginal vessels of the left part of the transverse colon and the upper part of the descending colon. My own observations during colectomy for carcinoma or colitis have concurred in showing that there is always a sizeable marginal artery present in the region of the splenic flexure connecting the superior and inferior mesenteric systems, and this vessel would appear adequate to nourish a considerable length of colon distal to the flexure. Accordingly I have been prompted to study the effects on the left colon of high ligation of the inferior mesenteric artery during rectal excision in 37 cases in the course of the last two years.

Table I.—VIABILITY OF LEFT COLON AFTER HIGH LIGATION OF INFERIOR MESENTERIC VESSELS DURING RECTAL EXCISION

Type of Operation Performed	No. of Cases Treated	Viability and Ultimate Fate of Left Colon after Application of High Ligature to Inferior Mesenteric Vessels		
		Circulation clearly Inadequate—Further Colon resected; Remainder survived in toto	*Circulation apparently Adequate; Bowel preserved*	
			Subsequent Sloughing	Survived *in toto*
Abdomino-perineal excision	25	3 cases	1 case	21 cases
Anterior resection with sutured anastomosis	7	2 cases	–	5 cases
Abdomino-anal excision (Bacon-Babcock technique)	5	—	2 cases (sloughing took place in bowel projecting beyond anus, ? due to sphincter contraction)	3 cases
All operations	37	5 cases	3 cases	29 cases

The procedure adopted was to tie the artery at its origin early in the course of the operation and then after the growth had been mobilized and was ready for excision to observe again the circulatory condition of the descending and upper sigmoid colon. In deciding on its viability attention was paid to the colour of the bowel, to the presence of pulsations in the small vessels in its wall, and, in all cases of doubt, to the occurrence of bleeding on division of one of these mural arteries. In most of the cases the type of operation performed was a combined abdomino-perineal excision, but a few were treated by anterior resection or abdomino-anal excision. When the circulatory condition of the left colon warranted its preservation the operation was completed exactly as if the main ligature had been placed below the origin of the left colic artery, the same amount of colon being retained for the formation of the colostomy or the anastomosis with the rectal stump or anus. The results as regards viability of the left colon are indicated in *Table I.*

DISCUSSION

It will be seen that in 32 of the patients, or roughly 3 cases in 4, after high ligation of the inferior mesenteric artery the blood-supply to the descending and iliac colon was considered at operation to be adequate for their survival. That this operative estimate was reasonably accurate is shown by the fact that in 29 of these cases the colon did survive *in toto*. Even in the 3 cases in which some necrosis

took place, it should be noted that this was confined to the terminal inch or two, and that in 2 of them in which a pull-through type of abdomino-anal excision had been performed a contributory factor in the production of the mortification was constriction of the bowel by the intact anal sphincters. The accuracy of the operative assessment of the circulatory condition of the colon may thus have been even greater than the bald statement of results might suggest. By the application of more stringent criteria at operation, labelling as non-viable colon which in some instances might conceivably have survived, it would seem possible to avoid preservation of the left colon in any case in which its blood-supply was not fully adequate. My experience would suggest that even with this more careful determination of viability it should be possible to retain the descending and iliac colon in the majority of cases undergoing rectal excision with high ligation of the inferior mesenteric artery.

It may be asked what advantages attach to retention of the left colon in these cases and whether it would not be simpler and safer always to resect up to the splenic flexure when it is necessary to sacrifice the left colic artery—as indeed I myself have recommended in a previous communication (Goligher, 1949). The first advantage is that in cases destined for a permanent colostomy this will be more easily managed by the patient if it is made in the iliac rather than in the transverse colon. The greater length of colon preserved with an iliac colostomy enables the colon contents to be accommodated for a longer time in the large bowel and exposes them to a larger area of absorptive colonic mucosa. As a consequence the colostomy motions are sooner reduced to one or two per day and more rapidly reach the normal semi-solid consistency than after a transverse colostomy. During the first six months or so after operation the iliac colostomy has thus a significant superiority in so far as the comfort of the patient and his early rehabilitation are concerned.

The second and main advantage of preserving the left colon is that it avoids an extension to the operation which is often technically somewhat difficult and not without dangers. The trouble is that neither the incision nor the position of the patient employed in the ordinary abdomino-perineal excision of the rectum are satisfactory for the resection or mobilization of the splenic flexure. It is, of course, not a difficult matter to enlarge the incision upwards into the epigastric region, adding a transverse cut across the left rectus if necessary, and to undo the Trendelenburg tilt or even tip the patient to the right side slightly if a suitable type of operating table is available, but, even if these steps are taken and the extended resection is thereby facilitated, it still represents a not inconsiderable addition to an abdomino-perineal excision. As it is, however, the surgeon frequently attempts to continue with but minor modifications in the incision and the position of the patient, lengthening the former an inch or so, and reducing the head-down tilt not quite to the horizontal. The result is that he frequently encounters difficulties which would not normally arise in the course of a formal resection of a splenic-flexure carcinoma, unless unduly adherent. The spleen is in unpleasantly close proximity to the colon, and on more than one occasion I have seen it torn during extended colectomy with rectal excision. It is possible that in a large series of cases treated by rectal excision with high ligation of the inferior mesenteric artery and resection of the greater part of the left colon, the additional risks associated with this latter step might be shown to offset the anticipated advantages in the form of a lower recurrence rate of the higher level of division of the superior vascular pedicle.

It is my opinion, therefore, that when performing high ligation of the inferior mesenteric artery during rectal excision the surgeon should not be hasty to resect the left colon. In the majority of these cases, after the ligation has been carried out it will be quite clear at operation that the marginal circulation to the descending and iliac segments is perfectly adequate, so that these parts may safely be preserved for the formation of an iliac colostomy or for an anastomosis. In a few the blood-supply will be clearly inadequate or there may be doubt about its sufficiency, so that if the colon were retained there would be a major risk of subsequent necrosis. Each case must be judged on its merits, but if after careful assessment of the arterial supply, the slightest dubiety remains, the safer course will obviously be to resect more bowel, taking immediate steps to secure the best possible access for this further resection. My experiences, however, would suggest that in at least 70 per cent of the cases after high division of the inferior mesenteric vessels during rectal excision, a decision can safely be made in favour of preservation of the left colon.

SUMMARY

The adequacy of the marginal blood-supply to the descending and iliac colon has been examined in 37 patients undergoing high ligation of the inferior mesenteric artery with sacrifice of the left colic branch during rectal excision.

In the majority of cases the remaining supply is sufficient for survival of the left colon, and a decision as to the viability of the bowel can be made with considerable accuracy at the time of operation.

The advantages of preserving the left colon where possible during excision of the rectum are discussed.

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THE TREATMENT OF DIFFICULT INGUINAL HERNIÆ WITH TANTALUM GAUZE*

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THE purpose of this article is to report the results of treating 47 cases of difficult inguinal herniæ in men by means of a tantalum gauze implant. The experimental work was done in 1946, and the first case was operated upon in January, 1947. The cases have occurred in hospital and private practice during the last five years, and no case is included in the results which has not been done for at least twelve months before this report. All had some reason for not employing the more orthodox methods—they were either large scrotal herniæ of long duration, recurrences following ordinary repairs, elderly people, or men with very weak musculature—and they were selected for these reasons only. In other words, they were all 'bad risk' cases from the point of view of recurrence.

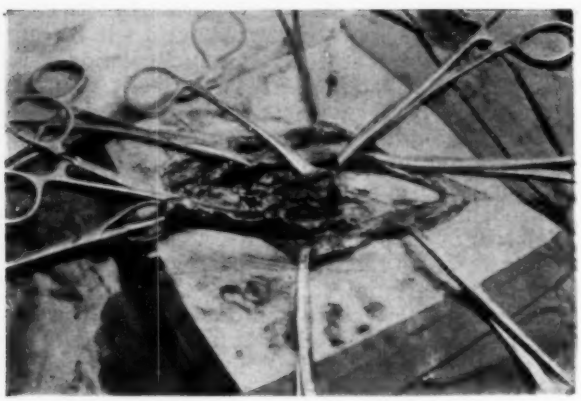

FIG. 423.—Photograph of operative findings, showing the yellowy-green discoloration and gelatinous appearances of the tissues surrounding a silver filigree inserted twenty years before.

For the sake of clarity and brevity, the dogmatic assertion is made that the integrity of the inguinal canal depends upon the integrity of its posterior wall, and that this in turn is dependent upon the integrity of the transversalis fascia. Once this has given way the development of a hernia, either direct or indirect, is inevitable, and will progress along the familiar paths as the other structures give way before it, according to the stresses which the individual imposes upon it.

That there are variations in the strength of the transversalis fascia in different parts of the abdomen and in different individuals must be the common observation of all abdominal surgeons. And it is at least likely that this variation is an important factor in determining the incidence of hernia in a series of physically fit individuals doing similar heavy work. It may also account for the fact that not all chronic bronchitics and chronic prostatics develop herniæ, even when account is taken of peritoneal 'dimples' and weak musculature.

These points are touched upon merely to lead to the conclusion that, if the assumption is correct, then the ideal procedure to cure a hernia is to replace the damaged and weak transversalis fascia by another and better fascia as the main buttress against recurrence.

Following this line of thought the analogy of 'reinforced concrete' came to mind, and some experimental work with rabbits was carried out in 1946 in collaboration with Dr. F. D. M. Hocking in his laboratory, using nylon gauze and tantalum gauze, which will be referred to later in the article.

Some twenty to thirty years ago it was fairly common practice to insert silver filigrees into large herniæ. They were used primarily as 'obturators' and the secondary reactions of the tissues, although noted, were not considered of great significance. They have now been abandoned because recurrence was so common, either on account of sepsis or because the reaction of the tissues to the silver produced only a weak form of fibrous tissue. And also, owing to the large calibre of the filigrees and the inflexibility of the material, there was often actual physical pain and discomfort mechanically produced, which necessitated their removal on that account.

Nevertheless, the following case seems worthy of report partly because of its historical interest, but more particularly because the photograph of the operative findings serves as a basis for the comparison of the reactions of the tissues to an active metal and those which occur after the use of an inert substance such as tantalum.

Case Report.—A commercial traveller, aged 48, attended the hospital in January, 1952, complaining of a recurrent left inguinal hernia. He stated that a silver filigree had been put in at another hospital over twenty years ago, following three recurrences and repairs by ordinary methods. The hernia had recurred a few months after the insertion of the filigree, and had steadily increased in size, and was now seriously troubling him. The presence of the filigree was confirmed by X rays, and at operation the condition as shown in the reproduction of the coloured photograph was disclosed (*Fig.* 423).

The yellowy-green discoloration of the tissues is well shown, and the generally gelatinous appearance of the whole area is to be noted. The filigree was loose and quite easily removable. The hernia was dealt with by the implantation of tantalum gauze by the method described later in the article, and the hernia has not recurred at the end of five months. It is not included in the results of the series under discussion.

Early in 1948 a case occurred which demonstrated the microscopical and histological changes that occur in the human tissues following the implantation of tantalum gauze. It also enabled a check to be made

* This article is based on a paper read before the Surgical Club of the South-West, at Truro, on May 2, 1952.

on experimental work which had been carried out in rabbits in 1946.

The case was that of a working man, aged 54, who had bilateral inguinal herniæ of large size. He was operated upon, by the method to be afterwards described, on both sides. Twelve days after his operation he had a sudden severe hæmatemesis and died. A post-mortem examination was carried out, and death was found to be due to perforation of his gastroduodenal artery by an acute peptic ulcer. This had no apparent relation to the operation, and he had made no complaint of gastric disturbance during his life.

The operation wounds had healed soundly by first intention. On one side the operation wound was opened, and an attempt made to pull the tantalum gauze out of the tissues. This was found to be quite impossible, and it came away piecemeal. There was obviously new fibrous tissue already present, which was all very tough and strong. The other side was dissected out carefully and photographed. In the reproduction of the photograph the detail can be well seen (*Fig.* 424). It will be observed that a sheet of tissue has already formed on the surface of the tantalum gauze. This sheet has been cut through for demonstration purposes with a knife, pulled back and held up by a piece of string. On the under-surface of the sheet of tissue many fibres can be seen passing through the interstices of the gauze from and to its deep surface, where there was also another sheet of tissue similar to the one seen in the photograph; this seems to suggest that a condition like reinforced concrete is in fact set up in the tissues, allowing the strands of tantalum to be incorporated in what will be an area of fibrous tissue. The strength of this depends, of course, on the same principle which makes it easier to break a tree trunk in half than to break a corresponding volume of twigs. Further, the interpolation of the strong tantalum fibres into the mass of fibrous tissue prevents it from stretching, at all events in the earlier formative stages. A grosser example of this process may be found in an article in the BRITISH JOURNAL OF SURGERY of July, 1948, by Lewin, Graham, and Northcroft, on "Tantalum in the Repair of Traumatic Skull Defects" (Figs. 68, 69), where thick processes of fibrous tissue are seen passing through drainage holes bored in tantalum plates.

Reproductions of two histological slides are figured. The first of these was from the back tissues of a rabbit upon which experimental work with nylon gauze was being done in 1946 (*Fig.* 425). By coincidence these appearances were present twelve days after implantation. Note the fineness of the fibrous tissue which is probably peculiar to the rabbit, but note also the foam cells, i.e., the foreign-body reaction. The second slide (*Fig.* 426) is from the sheet of fibrous tissue already seen in the photograph of the post-mortem specimen referred to above. Note the strength of the fibrous tissue, its regularity, and the complete absence of the foreign-body reaction. It is not necessary to elaborate this any further, except to reiterate that the tissue reaction had proceeded so far in twelve days that it was impossible to pull the tantalum gauze out of the tissues. To contrast this with the ease with which the silver filigree was removed could only be properly done by ocular demonstration.

It would seem, therefore, that the theory has worked out in practice.

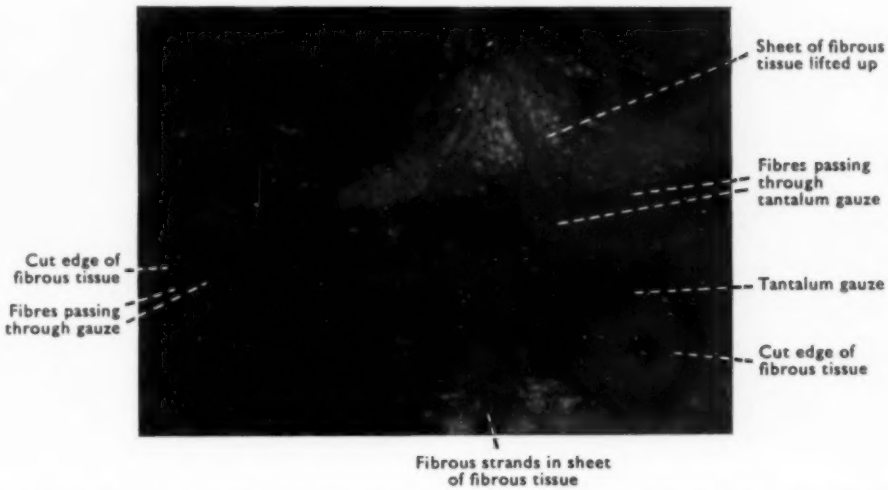
Sheet of fibrous tissue lifted up
Fibres passing through tantalum gauze
Cut edge of fibrous tissue
Fibres passing through gauze
Tantalum gauze
Cut edge of fibrous tissue
Fibrous strands in sheet of fibrous tissue

FIG. 424.—Photograph of specimen removed post mortem twelve days after implantation of tantalum gauze, showing the sheet of new fibrous tissue on the surface of the implant, and the fibres passing through the interstices of the tantalum gauze to its deep surface.

MATERIAL

When this work was begun an endeavour was made to get a mesh of stainless steel, but it was not obtainable, and so 50 × 50 mesh tantalum wire gauze was used. There is now a corresponding gauze in stainless steel, which is in fact stiffer than the tantalum gauze, and for this reason is perhaps not such a comfortable material to use. There is no specific reaction in the tissues to the tantalum any more than there is to stainless steel, but the curious thing is that tantalum of 32-gauge breaks experimentally at 483 flexions, as compared with the corresponding stainless steel, which breaks at 390 flexions, so that

in the question of fragmentation, to which reference will be made later, tantalum is a slightly better material than steel theoretically. However, it is easier to tie knots in fine steel than it is in tantalum wire, and the tantalum knot tends to break more

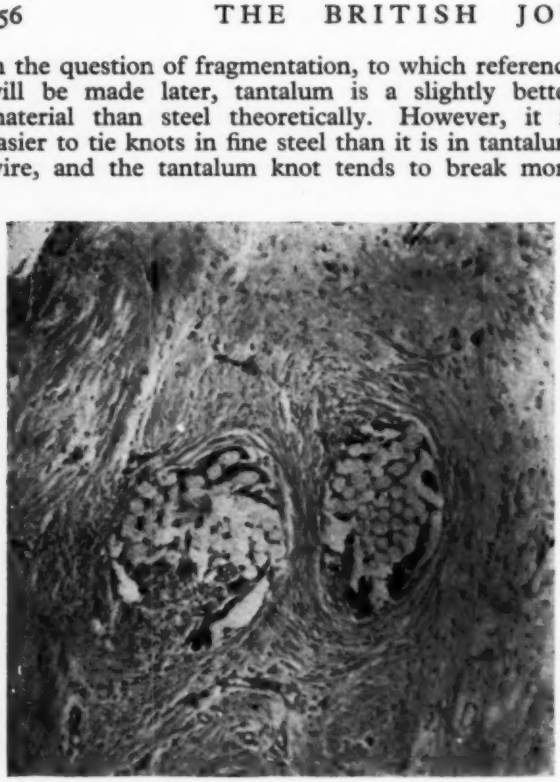

FIG. 425.—Photomicrograph of back tissues of a rabbit twelve days after the implantation of nylon gauze—showing the 'foam cell' foreign-body reaction.

easily than stainless steel. Nevertheless, the technique cannot be improved by using sutures of fine stainless steel to fix the tantalum in position, because of a different electrolytic potential between the two

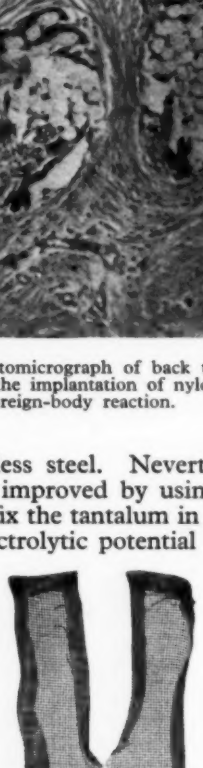

FIG. 427.—Photograph of a prototype of tantalum gauze before implant, to show shape, infolded edges, and bifid upper end which will surround cord.

metals. This would probably lead to a colliquative necrosis in the neighbourhood of the sutures, and should, therefore, not be done. The two metals differ in many ways, but on the whole tantalum gauze does all that is necessary, and can only be criticized on the grounds of relative expense.

METHOD

The technique of the operation is simple, but it requires careful attention to detail to get the results which are desired. The essential points to be borne in mind are :—

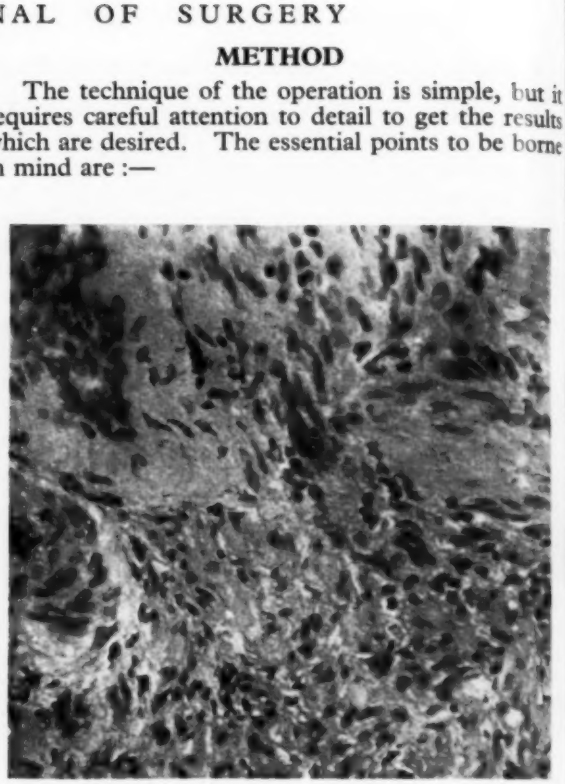

FIG. 426.—Photomicrograph of a piece of the fibrous tissue seen in *Fig.* 424, to show the regularity and strength of the fibrous tissue, and the complete absence of inflammatory or foreign-body reaction.

1. That the tantalum implant is literally to be implanted, and not thought of as having to take any stress or strain, and there must be no tension in the wound at all. The operation proceeds as in an ordinary inguinal hernia, but the anatomy must be defined, that is to say, Poupart's ligament, the conjoined tendon, and the transversus abdominis above. These *must* be defined, and in recurrences this may be a tedious procedure.

2. Except in direct herniæ the sac is isolated and dealt with in the usual way. In a direct hernia, unless it is of large size, it is unnecessary to open the sac. The cord must be completely isolated, especially in the upper portion, and the cremasteric artery divided if necessary. The cord may be reduced in bulk if large, and should lie quite loosely. The tantalum implant (*Fig.* 427) is cut by direct measurement and the edges infolded so that the stitches will not fray the gauze, and is designed as shown in the illustration. It will be recognized that this shape owes something to Mair's (1945) technique in using skin, and is an important factor for obvious reasons. The bifid end is passed around the cord very snugly, and this can be safely done because there is no inflammatory reaction, after which the two processes of the bifid extremity are then sewn together above the cord. The tip of the joined process is then transfixed with tantalum wire, and this is carried high up under the transversus abdominis. The lower portion is now sewn by at least two stitches on to the periosteum of the pubis and to the lowest part of Poupart's ligament behind the cord. It is well to note here that there is quite commonly an unnamed vein running across this area, and, if it is pricked

unwittingly, causes a hæmatoma which can give rise to pain for quite a time, and it is worth exposing this area to vision by retraction in order to avoid this. The implant should now lie quite loosely at the back of the canal, taking the place of the transversalis fascia, which it and the tissue reactions around it are intended to replace. The edges of the implant are now sewn to the under surface of the conjoined tendon, and to Poupart's ligament, by stitches of tantalum wire placed at intervals of about a quarter of an inch or so from one another. These stitches

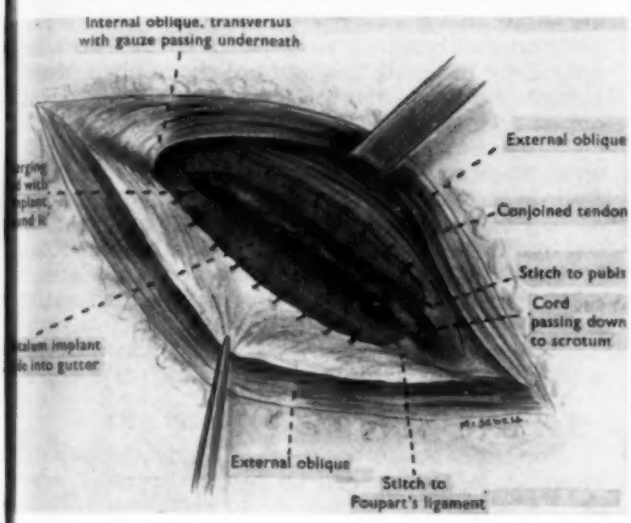

FIG. 428.—Line drawing of the state of affairs after implantation of tantalum gauze, and before closure of external oblique.

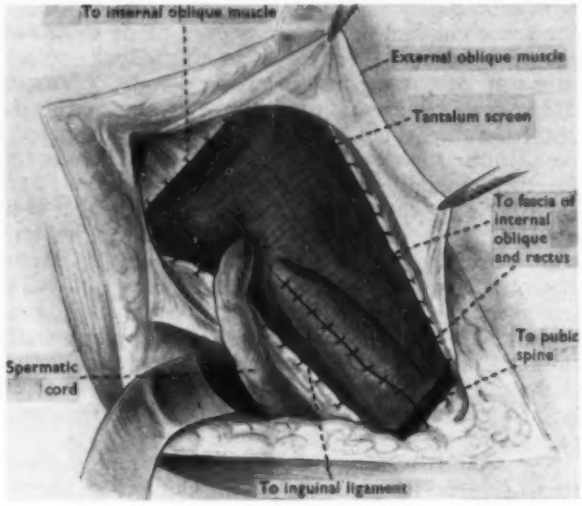

FIG. 429.—Line drawing to show details of Throckmorton's operation referred to in text.

are tied with a triple knot, and it is not necessary to pull them very tightly as there is danger of the knot breaking. The quarter-of-an-inch suturing is done to ensure apposition of the edges of the implant to the under surface of the conjoined tendon and Poupart's ligament over as wide an area as possible.

A line drawing (*Fig.* 428) is shown of the state of affairs when this stage of the operation is complete, which should make the technique quite clear. When finished the tantalum should not be under any stress, and the cord lies upon it, as it were, in a gutter. If the conjoined tendon is found to be not atrophied it is sometimes wise to put a nylon suture in the lower part of this to the lowest portion of Poupart's ligament, which is tied with practically no tension. This is an additional safeguard against further slide. Thereafter the external oblique is closed with nylon sutures in the ordinary way, and the operation is completed. There is no catgut used in the wound, even for tying vessels.

It will be seen that the conception behind this procedure is not that of sewing things together with consequent anatomical distortion in the hope they will join, but is in fact the putting up of a scaffolding around and through which a new 'transversalis' fascia may erect itself.

As has been said, the experimental work in connexion with this was done in 1946, and three successful operations were carried out in 1947, the first in January. There is no literature before 1948 of the use of tantalum gauze in the repair of inguinal hernia. In that year Throckmorton (1948), an American surgeon, reported a series of 15 cases without recurrence. In the reproduction of the line drawing of Throckmorton's operation (*Fig.* 429), which differs in several ways from the simpler technique which has been described, it will be seen that he distorts the point of exit of the cord, and attaches his implant on a more anterior plane, i.e., the rectus sheath.

It would seem that if a new transversalis fascia can be created, and it holds, then everything holds and the hernia is cured; and if this is the case it would appear to be a better technique to re-establish a transversalis fascia in its normal anatomical position, rather than in the way that Throckmorton does. The illustration suggests, too, that he used his gauze rather as an obturator than as a prosthesis, and this brings the factor of fragmentation and the fate of the implant into a more important position. Since, however, in his 15 cases there were no recurrences, criticism should not be harsh. Nevertheless, in the series here reported the length of time between operation and report is of such duration that the efficacy of the method described seems to be established from a long-term point of view.

Although the primary objective is the cure of a hernia, the approach is that of a fascioplasty rather than a herniorraphy.

RESULTS

There were, in the period under review, 47 herniæ operated upon in 39 patients, i.e., 8 cases were bilateral. Of these, 2 are untraced—they were Lithuanians in an agricultural camp which has now been dispersed, and it is not possible to trace them by any known means. It is, however, known that their herniæ had not recurred at the end of six months. They are not disclaimed, but excluded from the ultimate total. One man died of carcinoma of the rectum eighteen months after his hernia was operated upon in 1948. His doctor states that there was no recurrence at the time of his death. He has been excluded. All the cases were followed up and

examined for six months after operation, and it is known that the herniæ were satisfactory at this time, except for 3 recurrences. It is notorious that it is difficult to get reliable figures for hernia recurrences by any methods, and the snags associated with the questionnaire method are quite well appreciated. This method had to be adopted, however, because of the great distances that many of these elderly patients would have had to travel. Replies were received from all of them to a letter asking whether they had any disability from the operation, any return of the swelling, any pain, any discharge or discomfort, or whether they had had an operation elsewhere for the same condition. An offer was made to see and examine them, and 10 of them elected to come for this purpose, and have been personally examined. There was no complaint made of recurrence or disability in the others. Of the 10 cases who elected to be examined, 1 was a recurrence in a case done by a registrar. Eight came because they were so pleased with their operations and no other reason that could be seen. There were no recurrences. The tenth was the case of a man, aged 42, done in October, 1950, who came to complain of impotence following upon the operation. This was obviously psychological and easily explained, and although he came to hospital by bus, he went home by taxi! In short, these cases are completely satisfactory as far as can be ascertained, and most of them have stood up to test for three, four, and five years.

It would be possible to elaborate and dissect these figures in more detail, but no good purpose would be served.

The 3 Cases of Recurrence.—Two of these were done by registrars and had only had a piece of tantalum gauze put in at the lower end of the posterior wall as reinforcement, and did not embody the principles that have been laid down above, and are in fact an argument in favour of doing the correct operation.

The other recurrence occurred in the following circumstances: The patient was a man, aged 63, with a large scrotal hernia. He had symptoms of prostatism, and was operated on for his hernia as an emergency because it was strangulated, in May, 1949. At the operation it was found that there was a shortage of tantalum gauze, and because of this the implant was cut on too small a scale, and was not long enough to sew down to the pubis and Poupart's ligament without considerable tension. Therefore, another square piece was cut and laid over the bottom end and sewn to the pubis and Poupart's ligament, but it was not joined to the other bigger section, but merely overlapped it. He continued to have symptoms of prostatism for which he refused to have anything done, and in the course of examining him at intervals it was found that he had a recurrence. It was desired to operate on him again, but he would not agree. He returned late in 1951 with the recurrence strangulated. At the operation it was found that the hernia had pushed its way through the place where the tantalum had been overlapped—this must have occurred immediately. The gap in the tantalum was quite easily sutured with nylon after the hernia had been reduced. It is too recent to assess this result, but the hernia is still satisfactory after several months.

This was the only case in which the technique that has been described was departed from, and it is significant that recurrence occurred in the way it did. This hernia was under stress all the time from his bladder condition, and no further comment can be made.

SEQUELÆ

There have been one or two mildly septic hæmatomata with no untoward results. One hæmatoma in the lower end of the wound gave rise to pain for some time. In fact it was thought that it might be a recurrence—it was not so, however. There has been no local pain otherwise, and as far as can be judged, no disability arising from the implant of the foreign body, and the recovery from the operation has been entirely uneventful.

From experience in over five years, and this series of cases, Professor Zimmerman's (1952) statement in an article on "Recent Advances in Surgery of Inguinal Hernia" in connexion with the use of foreign material (*inter alia*, tantalum gauze) "that for the inguinal variety the added strength gained does not compensate, in my opinion, for the hazards and complications of their use" is too sweeping. There have been no hazards or complications of any moment in these 41 cases.

THE FATE OF THE IMPLANT

Professor Ascroft (1952), of the Middlesex Hospital, in a discussion on the treatment of large herniæ before the Section of Surgery of the Royal Society of Medicine, in December, 1951, said: "He spoke not as an advocate of tantalum, but merely as an observer of results. These results were good. A few of the implants fractured. About six months was the time after which one might expect a fracture to take place."

Of interest from the point of view of the fate of the implant and Professor Ascroft's remarks, reference is made to the X-ray findings in three of the cases in this series and brief details are given. (The radiographs are available, but it was considered that the detail would not be sufficiently clear after the necessary reduction in size for reproduction had been made.) They were all cases of large scrotal herniæ, and there were no recurrences when they were examined in April, 1952.

Case 1.—Large left scrotal hernia of many years' duration. The patient was aged 71. Operation, October, 1947. X-ray examination, January, 1948. Check radiograph, April, 1952, an interval of four and a half years. It can be seen that the tantalum is in exactly the same position and state as when it was put in.

Case 2.—Large left scrotal hernia of many years' duration. Patient aged 57. Operation, June, 1949. This case developed a painful hæmatoma at the lower end of the wound, which three months later was still present, and was thought at that time to be a recurrence. In January, 1950, seven months after operation, this had all subsided, and there was no recurrence. X-ray examination, January, 1950. Check radiograph, April, 1952, an interval of two years and ten months from operation. The tantalum is virtually in the same position as when put in. On close examination there is a suggestion of fragmentation, and some of the stitches have broken away. His own comment on examination

in April, 1952, was: "I wish I had had it done years before; I could wish for nothing better."

Case 3.—Large right scrotal hernia of thirty years' duration. Patient aged 48. Operation, March, 1948. First X-ray examination, March, 1948. Check radiograph, April, 1952, an interval of four years from operation. The appearance here is very interesting, since it shows a large hole in the middle of the implant. It is not possible to say when this first appeared, but there is no clinical sign of recurrence, and the man is doing full work as a labourer.

Finally, in the discussion before the Surgical Section of the Royal Society of Medicine already referred to, Mr. Norman Tanner (1952) is reported to have said that "he thought that there was over much talk of the necessity to have some foreign-body obturator to close the opening left by a large hernia". While it is possible to agree that the use of a foreign body as an obturator is undesirable in the cure of a hernia, nevertheless it may be wise, even at the risk of repetition, to emphasize that the use of the tantalum gauze in this method, and in this series of cases, was never intended to act as an obturator, but merely as a prosthesis for the re-creation of a sheet of tough fibrous tissue to replace the damaged transversalis fascia, which is the basic cause of any acquired inguinal hernia.

SUMMARY

The report is presented of the experience gained, and the results obtained, in 47 cases of inguinal hernia in men treated by an implant of tantalum gauze in the inguinal canal.

I am indebted to Dr. F. D. M. Hocking, Pathologist to the West Cornwall Clinical Area, for the post-mortem photographs and slides, and also for his continuing interest in the subject.

I am also indebted to Mrs. Clarke for the line drawings. Perhaps it would not be without interest to mention that Mrs. Clarke is the daughter of the late Mr. S. A. Sewell, whose well-known illustrations of surgical and pathological conditions added so much to the value of the BRITISH JOURNAL OF SURGERY in years gone by, and with which many are still familiar.

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SURGICAL TECHNIQUE IN THE TREATMENT OF DUODENAL ULCER BY ANTRODUODENECTOMY AND X-RAY IRRADIATION

BY GRAYTON BROWN

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THE results of subtotal gastrectomy in patients requiring surgery for duodenal ulcer have improved so much in recent years that there has been a feeling of complacency about this measure. However, although the operative mortality-rate is low, the morbidity is quite appreciable, consisting of either the disabling 'post-gastrectomy' syndrome or a failure to gain weight, and once a radical gastrectomy has been performed the surgeon can do little to help these unfortunate people. These unsatisfactory results encouraged my medical colleagues and myself to consider limited gastroduodenal excision, including removal of the ulcer, followed by some simple measure to lower the acid and pepsin secretion of the stomach.

The operation finally decided upon was removal of the ulcer-bearing portion of the duodenum together with the gastric antrum, 'antroduodenectomy', and the method chosen for diminishing the gastric secretions was the accurate administration of X-ray irradiation. The principles of the treatment and a preliminary report of the results have already been described (Brown, Smith, Holman, Wood, Finckh, Weiden, and Davis, 1952). Details and results of the X-ray irradiation have been recorded by Scott, Holman, and Finckh (1953).

The purpose of this paper is to discuss the failings of subtotal gastrectomy, to justify our adoption of antroduodenectomy with X-ray irradiation, and to describe the operative technique of antroduodenectomy.

MORBIDITY AND MORTALITY OF SUBTOTAL GASTRECTOMY

Recurrent ulceration after gastrectomy is uncommon now that surgeons remove a major portion of the stomach, including most of the acid-secreting area. Moreover, the mortality-rate immediately after operation is admittedly small. In my own series of 94 cases where the standard Polya subtotal gastrectomy was performed, there was only 1 hospital death, this being caused by coronary thrombosis in a man aged 68 with quite a severe degree of aortic stenosis. This series is not large and I have indeed been fortunate—there must always be an occasional death following such a radical operation. The mortality-rate for the classical Polya gastrectomy by fifteen surgeons at the Royal Melbourne Hospital was 4·5 per cent in a series of 241 elective gastrectomy operations performed for peptic ulceration in 1947–9 (Brown, 1951).

However, the morbidity rate following Polya subtotal gastrectomy demands our close attention. The facts can only be elicited by personal, frequent, and thorough interrogation and examination of our patients over a number of years. In my series of 94 patients, 6 suffered from severe post-gastrectomy symptoms. The most common symptoms were a

feeling of fullness during meals, followed by nausea which persisted for about three hours, when the patient might vomit about one pint of bile but only little food. This has been appropriately called the 'small stomach' or 'afferent loop' syndrome. It should not be confused with the less commonly occurring 'dumping syndrome', consisting of a sudden feeling of faintness, emptiness, sweating, and pallor which has been variously ascribed to the rapid absorption of sugar followed by hypoglycæmia (Moore, 1950) or to potassium lack (Smith, 1951).

The number of contributions to the literature on this subject bears testimony to the fact that many surgeons are far from pleased with their present results (Butler and Capper, 1951; Goligher and Riley, 1952; Machella, 1950; O'Neill, 1950; Pulvertaft, 1952; and Wells and Welbourn, 1951). It may be that some of those surgeons who claim constantly good results have not had the facilities to conduct a thorough follow-up. It is often the dissatisfied patient who does not return.

In addition to those of my patients who were seriously disabled, there were others who, although pleased with the relief of their ulcer symptoms, did not regain their pre-operative weight or even lost weight. This morbidity, together with the accepted mortality after the standard Polya gastrectomy, led us to seek a less radical and more rational method of surgical treatment. Our decision was based on the following considerations and conclusions.

The duodenum being the commoner site of peptic ulceration, gastroduodenostomy (Billroth I) has been generally discarded for the more easily performed gastrojejunostomy (Billroth II). However, in my opinion it would appear that any operation involving anastomosis of the stomach to the jejunum has such disadvantages that it should be carried out only when a satisfactory gastroduodenostomy cannot be made—this is not often the case when the anatomy of the ulcer-bearing portion of the duodenum is carefully studied. It is probably a considerable disadvantage to distort the normal physiology by causing the food to by-pass the second part of the duodenum, for this not only reduces the stimulus to bile flow and pancreatic secretion, but also prevents the satisfactory mixing of the food with these secretions as it passes the ampulla of Vater. These secretions, reduced in amount, first traverse the length of the afferent loop of the jejunum, then 'chase' the food down the alimentary tract, or occasionally are vomited.

The small size of the stomach in this operation is accentuated by the absence of any anchorage at the distal end. In 3 cases of severe post-gastrectomy syndrome which were subjected to a second laparotomy some years after operation, the stomach remnant was found to be retracted up under the diaphragm and fixed there by quite firm adhesions. In any form of Billroth I operation the lower end of the stomach is fixed to the duodenum and the stomach maintains a larger size by virtue of it being tethered at both ends.

Probably as a result of these two factors, the by-passing of the duodenum and the reduction of gastric capacity, few patients regain their normal weight after subtotal gastrectomy. This, of course, is a small price to pay for being rid of their severe ulcer symptoms. Some patients actually lose weight and strength and suffer from mild to moderate malnutrition, yet they enjoy better health than before operation. But the surgeon must provide complete and lasting ease. We must not be satisfied with partial cure.

PRINCIPLES OF ANTRODUODENECTOMY

Cases of duodenal ulcer may be placed in one of four main groups according to the nature of the ulcer and the symptoms if produces :—

Group 1 : Acute or subacute ulcer which heals with medical treatment within twelve months.

Group 2 : Chronic ulcer which does not completely heal, but the relapses are not severe, and are tolerable with conservative medical treatment.

Group 3 : Chronic ulcer which does not heal, and is intolerable by virtue of the frequency or severity of the relapses even with full medical treatment.

Group 4 : Chronic ulcer producing severe or repeated complications such as hæmatemesis or obstruction.

Surgical treatment is required for the ulcer which does not heal and produces intolerable pain or severe complications (Groups 3 and 4). The minimal and most rational surgical procedure appears to be local excision of the ulcer accompanied by measures to prevent recurrence. A small sleeve resection is the most satisfactory method for local excision. In our first patient this was found to include most of the first part of the duodenum and, of necessity, the pylorus and part of the gastric antrum. Further consideration led to the removal of all the antrum in order to gain some benefit from the excision of this potential ulcer-bearing area, for if allowed to remain it appears to play a part in subsequent ulceration (Dragstedt, Oberhelman, and Smith, 1951).

There will be, of course, certain duodenal ulcers which are too large for excision; they require proximal closure of the duodenum followed by a Billroth II type of anastomosis. But these will be the exception, because with careful dissection almost all duodenal ulcers can be excised leaving sufficient healthy tissue distal to the ulcer for gastroduodenal anastomosis.

The measure employed for reducing the risk of recurrence at present being used in this series is X-ray irradiation, a total of 2000 r being given over a period of three weeks. An accurately applied technique is required and this is described in detail elsewhere (Scott and others, 1953).

The effects of X-ray irradiation were studied by serial histamine test-meals and gastric biopsies, using the flexible gastric biopsy tube described by Wood, Doig, Motteram, and Hughes (1949). Test-meals showed considerable reduction of the secretion of acid, and gastric biopsies revealed moderate atrophy of the acid and pepsin secreting cells together with some inflammatory reaction. The maximum effect on gastric secretion was observed one to three months after irradiation. Now that the nature of the histological changes has been established, gastric biopsy need no longer be performed as a routine, reliance being placed on histamine test-meals (Brown and others, 1952).

Should there be recurrent ulceration following antroduodenectomy, it would still be possible to

carry out a subtotal gastrectomy. This has not been required in this series as yet, but the period of follow-up has been no more than one year. Five years or more must pass before the relapse rate for this conservative operation can be assessed.

ANATOMY OF DUODENAL ULCERS

All ulcers in the first part of the duodenum will be situated anterior to the head of the pancreas and, in those which penetrate, the eroded part of the pancreas will be the anterior surface of the head; the ulcers are therefore at a safe distance from the entry of the common bile-duct and pancreatic ducts into the duodenum (*Fig.* 430).

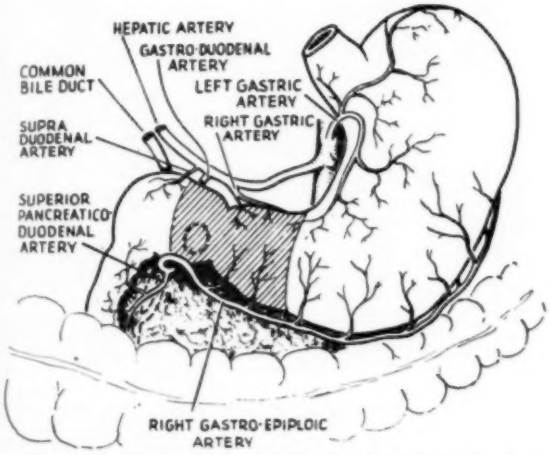

FIG. 430.—The anatomy of the gastric antrum and first part of the duodenum in relation to the blood-vessels and common bile-duct. The hatched area represents the segment removed in antroduodenectomy (illustrated in *Figs.* 431–438).

The first part of the duodenum begins at the pylorus and ends where it becomes the second part by turning inferiorly along the right margin of the head of the pancreas. Here it is in relation posteriorly to the anterior surface of the head of the pancreas. The proximal portion of the first part of the duodenum is completely surrounded by peritoneum which superiorly becomes the lesser omentum enclosing the common bile-duct, hepatic artery, and the right gastric artery, and inferiorly becomes the greater omentum enclosing the right gastro-epiploic artery. The gastroduodenal artery passes behind the first part of the duodenum, giving off several duodenal branches. All duodenal ulcers in the first part of the duodenum will be situated anterior to the head of the pancreas, and most penetrating ulcers will be a safe distance from the ampulla of Vater. As the common bile-duct leaves the free border of the lesser omentum to turn posteriorly behind the pancreas, it is in relationship to the upper border of the distal portion of the first part of the duodenum. During excision of ulcers extending to this area the common bile-duct may be in some danger. However, the duct is distal to the right gastric and supraduodenal arteries, and it is not until these vessels have been ligated and divided that special care must be exercised in its identification.

It is therefore safe to remove most duodenal ulcers from the anterior surface of the head of the pancreas, dissecting towards the right until the gastroduodenal artery is located. By this time the œdematous or scar tissue in the region of the ulcer has been freed and normal duodenal wall is reached. It can be mobilized further by ligating and dividing some duodenal branches of the gastroduodenal artery. This will make an adequate length, at least 1·5 cm., of normal duodenum available for gastroduodenal anastomosis. Indeed, I believe that it is easier and safer to use this cuff of duodenum for anastomosis with the stomach than to infold it as a blind stump.

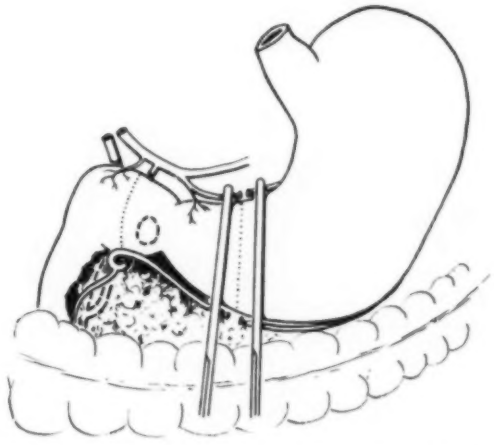

FIG. 431.—The site of division of the stomach in antroduodenectomy with ligation and division of left gastric and right gastro-epiploic vessels.

In occasional cases the ulcer is overlying the gastroduodenal artery, necessitating dissection to the right of this vessel. Here there is some risk of dissecting near the common bile-duct, which should be identified in the free edge of the lesser omentum and traced down to the duodenum. Usually it is found to be a safe distance from the dissection.

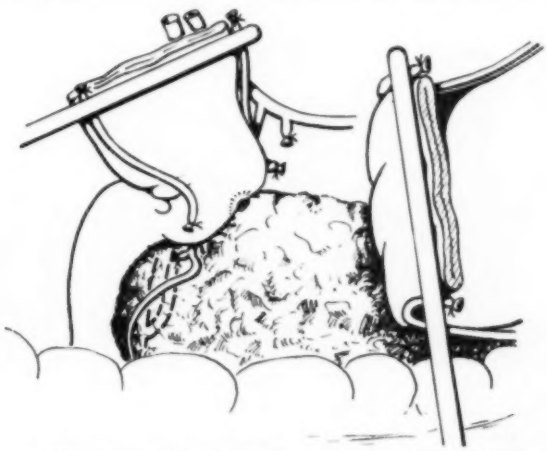

FIG. 432.—The antroduodenal segment drawn across to the right to display the anterior surface of the pancreas and the edge of the penetrating ulcer, after ligating and dividing the right gastric, supraduodenal, and right gastro-epiploic vessels.

TECHNIQUE OF ANTRODUODENECTOMY

Patients are admitted to hospital at least seven days before operation and prepared with rest in bed and medical treatment. Should the pain be persistent this will include a continuous intragastric drip

of high caloric milk fluid (Garlick, 1949). Anæmia is corrected by iron medication, and if necessary, by transfusion. Breathing exercises are given to minimize the possibility of post-operative pulmonary collapse. Two days before operation prophylactic chemotherapy is begun, consisting of 500,000 units of penicillin eight-hourly and ½ gramme of streptomycin twice daily, and continued for at least five days after operation. Immediately before operation, the stomach is emptied by means of a Ryle's tube, which is left in situ and a slow intravenous infusion of glucose is begun; in severe and difficult cases blood is added during operation.

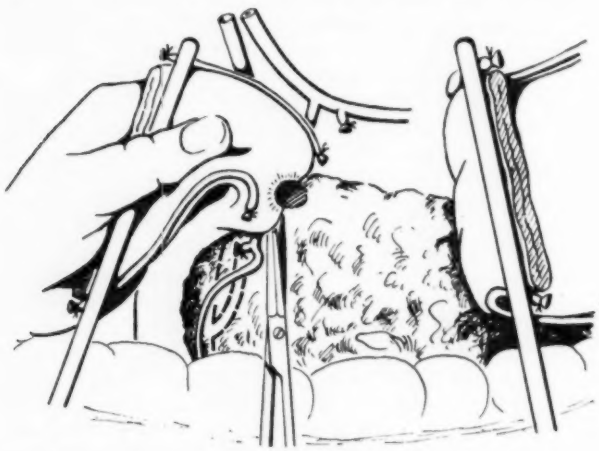

FIG. 433.—The duodenum being dissected off the pancreas, leaving the ulcer crater on the pancreas. The plane of dissection is outside the adventitial coat.

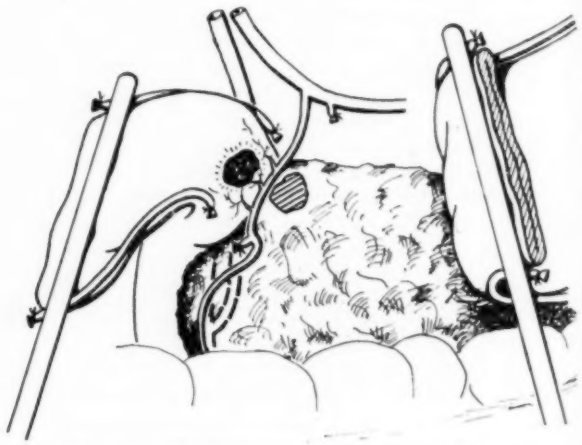

FIG. 434.—The duodenum has been dissected, leaving the ulcer crater on the anterior surface of the head of the pancreas. The gastroduodenal artery is exposed and the duodenal branches are identified.

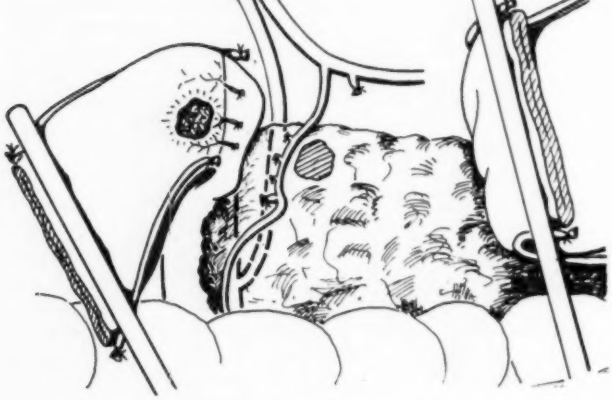

FIG. 435.—The duodenal branches have been ligated and divided, liberating all the first part of the duodenum. The common bile-duct has been identified at the upper border of the duodenum.

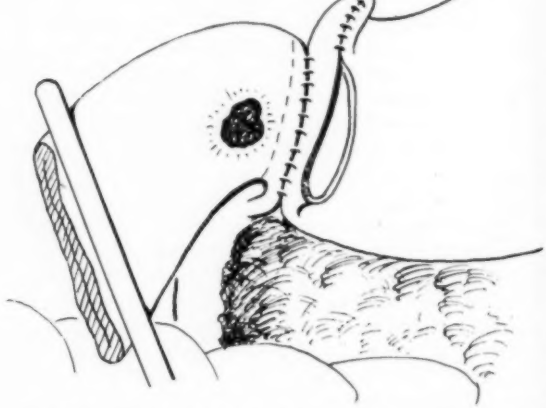

FIG. 436.—The opening into the stomach has been reduced to suit the duodenal lumen and the posterior layer of serosal silk sutures has been completed.

The abdomen is opened through an upper midline or right upper transverse incision. The viscera are examined and the exact location of the ulcer is determined. The lesser sac is opened through the gastrocolic omentum close to the greater curvature. Through this opening the posterior wall of the stomach and the first part of the duodenum are inspected and palpated. The constant but avascular adhesions passing from the posterior surface of the pylorus to the head of the pancreas are divided with scissors to expose the first part of the duodenum.

The gastrocolic omentum is divided between artery forceps from the point on the greater curvature opposite the incisura down to the first part of the duodenum. The right gastric arterial branches are secured between artery forceps and the lesser omentum is divided from the incisura to the first part of the duodenum where the supraduodenal artery is ligated and divided. The stomach is divided transversely at the level of the incisura between a rubber-covered clamp gently applied to the proximal side and a light Payr's clamp distally (*Fig.* 431). The distal portion (pyloric antrum and pylorus) is turned across to the right, giving a full view of the posterior surface of the first part of duodenum (*Fig.* 432). The posterior wall of the duodenum is carefully dissected off the head of the pancreas with scissors, keeping to the plane immediately outside the adventitial coat (*Fig.* 433). The gastroduodenal artery is exposed during this procedure and the short branches from this vessel to

the duodenal wall, usually four to eight in number, are ligated and divided (*Fig.* 434).

When the dissection has been carried past the level of the ulcer, if necessary to the beginning of the second part of the duodenum, the head of the pancreas lies exposed, with the gastroduodenal artery running vertically across its anterior surface (*Fig.* 435). If the extent of the ulcer requires the common bile-duct to be approached, the duct should be dissected out to determine its exact relationship to the ulcer.

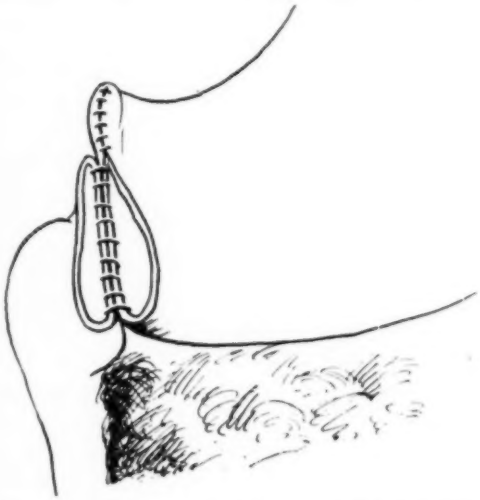

FIG. 437.—The antroduodenal segment has been resected and the posterior layer of continuous atraumatic catgut inserted.

As the diameter of the gastric opening exceeds that of the duodenal stump, the necessary amount of closure down from the lesser curvature is made, using two layers of sutures (*Fig.* 436). However, every care must be taken to avoid too much closure of the stomach. It is essential to obtain a full diameter for the anastomosis, otherwise partial obstruction may occur in the immediate post-operative period.

By holding the Payr's clamp across to the right, the posterior wall of the duodenum is approximated to the posterior wall of the stomach, and a series of interrupted silk sutures are placed between these two surfaces (*Fig.* 436).

The antroduodenal resection is completed by dividing the duodenum just proximal to the line of silk sutures (*Fig.* 437). Continuous atraumatic catgut secures hæmostasis and mucosal apposition around the posterior and anterior walls, then interrupted silk sutures to the serosal coat on the anterior wall complete the anastomosis (*Fig.* 438).

After operation, chemotherapy is continued for at least five days and the patient is encouraged to cough and breathe deeply. The stomach is aspirated four-hourly for the first two days, then less frequently. Apart from sips of cold water to keep the mouth and larynx moist, nothing is allowed by mouth for two days, then one ounce of 10 per cent glucose in half normal saline is given hourly until it is evident from the decreasing aspiration volumes that fluid is passing through the anastomosis. This usually takes from two to five days. During this period a positive fluid balance is maintained by intravenous infusion of glucose-saline. The Ryle's tube is then removed and fluid nourishment given for a further four days, followed by semisolid food for a week and then a normal diet.

Early ambulation is possible and is indeed an essential part of the post-operative treatment in that it appears to diminish chest complications and assist in the development of normal peristalsis. Most of our patients sat out of bed on the third day even if the Ryle's tube had not already been removed. They were usually walking about the ward before the end of the first week.

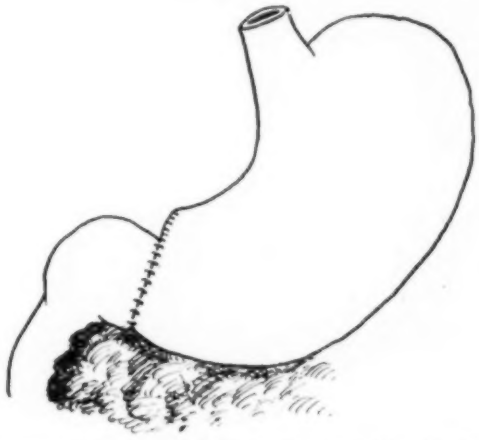

FIG. 438.—The completed anastomosis indicating the size of the fundus and body of the stomach.

Once the anastomosis has begun to function, magnesium trisilicate and belladonna are given four-hourly, and these are continued until the course of X-ray irradiation is completed some eleven weeks later.

POST-OPERATIVE RESULTS OF ANTRODUODENECTOMY

This operation of antroduodenectomy has been carried out as a routine for cases of severe duodenal ulcer since December, 1951. During this period 31 cases have been so treated.

In 29 cases the operation was successful, the only event of note in the post-operative period being the time taken for the anastomosis to function sufficiently well to permit removal of the Ryle's tube. In 20 cases the tube was removed after three days, in 4 after four days, in 2 after five days, in 2 after six days, and in 1 after eight days. Twenty-eight of these cases have all remained well and free of symptoms for an average period of seven months. The remaining case, who also suffered from chronic nephritis, has had occasional dyspepsia.

In the other two cases the operation was not successful, and their clinical course was as follows :—

Case 1.—A. T., a female aged 72 years, had a penetrating ulcer with a recent severe hæmatemesis. Four days after operation the anastomosis appeared to be patent but she began to vomit and, despite the Ryle's tube being left in for fourteen days, complete obstruction at the anastomosis persisted. At laparotomy on the fifteenth day an inflammatory induration was found at

the site of the anastomosis, but there was no abscess formation. A gastro-enterostomy was performed with a satisfactory convalescence.

Case 2.—A. McK., a debilitated man aged 76 years, suffered from continuous severe pain resulting from a large

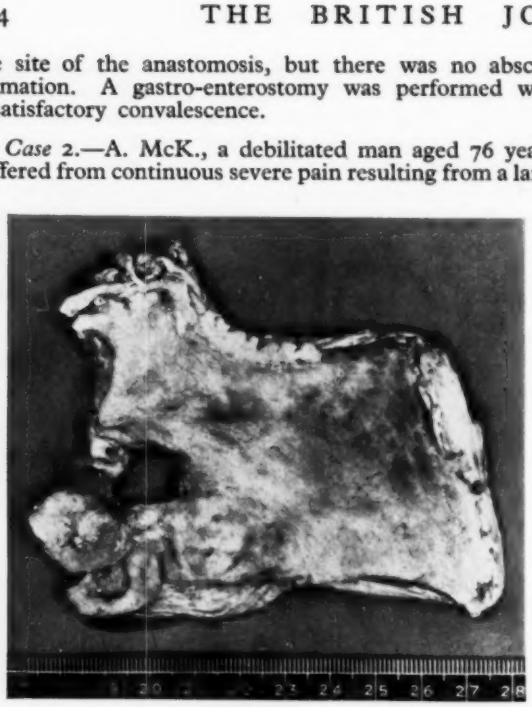

FIG. 439.—*Case* 3. The portion of duodenum and gastric antrum removed at antroduodenectomy. The lumen has been opened, revealing a large penetrating duodenal ulcer.

FIG. 440.—*Case* 3. Barium meal before antroduodenectomy. Radiologist reported deformed duodenal cap with a moderately large ulcer crater on the upper border of the duodenum.

FIG. 441.—*Case* 3. Barium meal six months after antroduodenectomy. Radiologist reported that a liberal amount of stomach remained and there was normal emptying past the site of anastomosis.

penetrating ulcer. I now realize that this ulcer was too large for safe resection in a man of this age. On the tenth post-operative day he suffered an acute perforation at the site of the anastomosis. Laparotomy and drainage was immediately performed. However, he developed a recurrence of pain after four weeks which was not relieved by medical treatment; six weeks later he suffered a severe hæmatemesis which proved to be fatal. At post-mortem examination an anastomotic ulcer was found to have penetrated the gastroduodenal artery.

The following case is representative of our successful group and the surgical aspects are described in some detail; a full report on the effects of X-ray irradiation and the results of serial test-meals and gastric biopsies in this case has been made by Scott and others (1953).

Case 3.—K. M., a male aged 44 years, was seen in hospital in April, 1952. He had a history of epigastric pain occurring in attacks for ten years. He suffered two hæmatemeses, four and three years previously. For the past three months the pain had been constant and severe, with radiation to the back and accompanied by attacks of vomiting, despite rigid adherence to diet, alkaline powders, and belladonna. Weight: 10 st. 7 lb. (loss of 21 lb. in twelve months). Barium meal: deformed duodenal cap with a moderately large ulcer crater on the upper border of the duodenum (*Fig.* 440). Histamine test-meal: maximum free acid 60 degrees. A penetrating chronic duodenal ulcer was diagnosed and the patient readily agreed to surgical excision followed by X-ray irradiation.

After fourteen days in hospital, when he was given a high caloric diet, alkali, and belladonna, antroduodenectomy was performed. At operation the ulcer crater was found to be in the first part of the duodenum (*Fig.* 439). It was 1·5 cm. in diameter and penetrating into the anterior surface of the head of the pancreas in the region of the gastroduodenal artery. The duodenum was dissected off the pancreas, leaving the bed of the ulcer with the gastroduodenal artery lying behind it. The common bile-duct was identified and found to be at some distance from the first part of the duodenum, so a further 1·5 cm. of normal duodenum was dissected

free from the pancreas. To achieve this, it was necessary to ligate and divide six duodenal branches of the gastroduodenal artery. A gastroduodenal anastomosis was then performed without difficulty.

During the first forty-eight hours after operation, amounts of about 4 oz. were aspirated four-hourly through the Ryle's tube; 10 oz. were obtained on two occasions. On the third day a total of only 10 oz. was aspirated, although 1 oz. of glucose-saline was given by mouth each hour. On the fourth day the Ryle's tube was removed and the patient sat out of bed. His bowels opened spontaneously. A light diet was now taken together with 60 gr. of magnesium trisilicate and 15 min. of tincture of belladonna four times a day. Histamine test-meal on the eighth day after operation: maximum free acid 80 degrees. The sutures were removed on the tenth day and he was discharged home on a full ulcer diet twelve days after operation.

Eight weeks after operation he began X-ray irradiation—he had been symptom-free since leaving hospital. The course of X-ray irradiation, consisting of a total of 2000 r given over a period of three weeks, did not cause any symptoms. On completion of the course he was instructed to relinguish all dietetic restrictions and the taking of magnesium trisilicate and belladonna.

Six months after operation he was still symptom-free, was eating large meals without discomfort, and had gained 5 lb. in weight since before operation. He was playing strenuous tennis. A barium-meal examination was made by Dr. Peter Davis, who reported: "The stomach is of normal size and empties as does a normal stomach, with active peristalsis and slight hold-up at the pylorus. The stomach was about half empty in thirty minutes. The mucosal pattern around the anastomosis is normal." (*Fig.* 441.) Gastroscopy revealed normal gastric mucosa and the stoma was patent and of normal appearance. Following X-ray irradiation, serial test-meals showed considerable reduction in the secretion of acid, and gastric biopsies revealed moderate atrophy of the acid and pepsin secreting cells together with some inflammatory reaction.

Results such as this, where a patient suffering from a chronic penetrating duodenal ulcer has been restored to normal health and vigour, have given us much encouragement. With the passing of time we are gaining confidence in our belief that antroduodenectomy followed by X-ray irradiation is superior to subtotal gastrectomy. But we fully appreciate the fact that many years must elapse before final assessment can be made.

SUMMARY

1. The morbidity after the Polya subtotal gastrectomy for duodenal ulcer is too high for the operation to be regarded as satisfactory. In my own limited experience of 94 cases so treated, 6 suffered from moderate to severe 'post-gastrectomy' symptoms, notably pain, debility, nausea, or vomiting; others complained of minor grades of weakness and failure to regain their normal weight. Recent contributors to medical literature have reported similar results.

2. To reduce the incidence of this post-operative morbidity the aim of the surgeon should be to remove the duodenal ulcer, to maintain the normal food channel (gastroduodenostomy) and to remove a minimal amount of stomach yet avoiding the risk of recurrent ulceration. The procedure employed should subject the patient to a minimum of risk.

3. To meet these requirements the procedure of antroduodenectomy followed by X-ray irradiation of the stomach to reduce the gastric secretion is advocated.

4. In the operation of antroduodenectomy there is limited resection, which includes the gastric antrum and the first part of the duodenum containing the ulcer. This is followed by gastroduodenostomy. It is considered highly desirable and usually possible for duodenal ulcers which are severe enough to require surgery to be excised together with the surrounding area of fibrosis. A further mobilization of the duodenum enables a gastroduodenostomy to be performed with more safety than closure of the duodenum as a blind stump.

5. X-ray irradiation of the stomach has reduced the secretion of acid and caused no subsequent disability.

6. A limited series of 31 patients have been subjected to antroduodenectomy for severe chronic duodenal ulcer.

In 29 patients the post-operative results were satisfactory. Of the remaining 2 patients, post-operative obstruction occurred in one at the site of anastomosis and this was successfully relieved by gastro-enterostomy; a fatal hæmatemesis from an anastomotic ulcer occurred in the other patient, a male, aged 76 years, who had been operated upon ten weeks previously for a large penetrating duodenal ulcer.

7. Although this series is as yet limited in numbers and period of follow-up, we are encouraged by our early results.

Acknowledgements.—The principles of this operation and the use of X-ray irradiation post-operatively were originally suggested by my colleague, Dr. Ian Wood, Clinical Research Unit, Walter and Eliza Hall Institute of Medical Research and Royal Melbourne Hospital. Mr. Orm Smith has given me advice and helpful criticism in the technique and after-treatment of the operation. Dr. W. E. King has been most generous in referring cases for operation and assisting with the medical management. I am indebted to Miss J. Wood for illustrating the steps in the technique of antroduodenectomy.

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FAMILIAL INTESTINAL POLYPOSIS WITH PIGMENTATION OF THE FACE, LIPS, MOUTH, AND DIGITS

By C. R. SAVAGE, London

Almost thirty proven cases of this interesting syndrome have been recorded. It was originally described by Peutz (1921), from Holland, affecting several members of the same family. The largest series (10 cases) has been that of Jeghers, McKusick, and Katz (1949), from America, whilst in this country

Fig. 442.—Photograph of patient showing melanin spots on face and hands.

cases have been described by Foster (1944), 2 cases, Tanner (1951), 1 case, and Wolff (1952), 1 case. A number of other probable cases have also been reported.

The essential features of the syndrome are the distinctive melanin spots scattered around and inside the mouth and the polyposis of the small intestine. A full discussion of the subject is given in the articles of Jeghers and others (1949) and of Wolff (1952). A further case is here reported on account of the general interest of the syndrome and its familial incidence.

CASE REPORT

A man aged 28 (*Fig.* 442) was admitted to St. Thomas's Hospital on Dec. 31, 1951, complaining of recurrent attacks of abdominal pain and vomiting for the last nine years. Previously his health had been good. The first of these attacks occurred in 1943 whilst in the Services; a diagnosis of acute intestinal obstruction was made and laparotomy carried out. This revealed three separate intussusceptions due to adenomatous polyps of the small intestine. The intussusceptions were reduced and the polyps excised. Numerous other polyps, some large and some small, were noticed throughout the length of the small intestine. Since that time he had had four further operations for obstruction due to the same cause (two in 1948, one in 1949, and one in 1950). More polypi had been removed and segments of intestine had been excised on two of the occasions. There had in addition been numerous attacks of pain and vomiting which had responded to conservative treatment. At the present time he was getting one or two attacks a week. He had had no hæmatemesis or melæna.

Examination showed him to be well covered, dark complexioned, but very pale. There were brown pigmented spots around his nose and mouth and scattered over the inside of the cheeks, lips, and palate.

Fig. 443.—Coloured drawing of polyp removed at operation.

Similar spots were also present on the backs of his hands and to a much lesser extent on the backs of his feet. As far as he could remember these spots had always been present. Apart from the scars on his abdomen there were no other abnormal physical signs. Hæmoglobin was 66 per cent, blood-urea 20 mg. per 100 c.c. Sigmoidoscopy showed no abnormality. A barium meal showed polypi in the duodenum, a polyp in the jejunum, and a probable intussusception in the ileum.

In the first fortnight following admission he had two attacks of intestinal obstruction, both of which resolved with conservative treatment. Hæmoglobin was restored to normal by blood transfusion. In view of the frequency of the attacks, operation was carried out on Jan. 23, 1952, by Mr. R. H. Boggon. This revealed widespread polyposis of the small intestine from the duodenum almost down to the ileocæcal valve. The stomach and large bowel from external examination appeared unaffected. The polyps were largest and most numerous in the jejunum and there was a chronic intussusception in the ileum, the peritoneal coats of which were firmly adhered together over a length of about 3 in. The polyp responsible for this, together with the internal traction diverticulum which it had produced, were excised, as were also several large polyps in the jejunum which were considered those most likely to be the starting points of future intussusceptions. Convalescence from operation was uneventful. Microscopical examination showed the polyps to be adenomatous (*Fig.* 443.)

The patient states that neither his parents nor any of his five brothers have any pigmented spots about them, nor any symptoms of gastro-intestinal

upset. The only member of his family who appears to be affected is his only child, a boy of 4 years of age, who has had similar pigmented spots around his face and mouth since birth. It is not known whether he, too, has polyposis.

I am grateful to Mr. R. H. Boggon for his permission to publish this case.

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SMALL-INTESTINE POLYPOSIS ASSOCIATED WITH A CHARACTERISTIC CIRCUMORAL PIGMENTATION

BY MERVYN SMITH
FORMERLY SURGICAL REGISTRAR, SOUTHEND-ON-SEA GROUP OF HOSPITALS

IN 1896, Jonathan Hutchinson described in a pair of twins the occurrence of an unusual type of black pigmentation on the lips and mucous membrane of the mouth. Parkes Weber (1919) stated that one of the twins had died with an intussusception at the age of 20, but it is only more recently that the probable nature of the condition has been revealed. Peutz (1921) described a syndrome of intestinal polyposis associated with skin pigmentation, and the description of 10 such cases by Jeghers, McKusick, and Katz (1949) has now established the syndrome. Isolated cases have been described from time to time, and recently Wolff (1952) has reviewed the literature, collecting 26 proven cases and adding 1 case of his own.

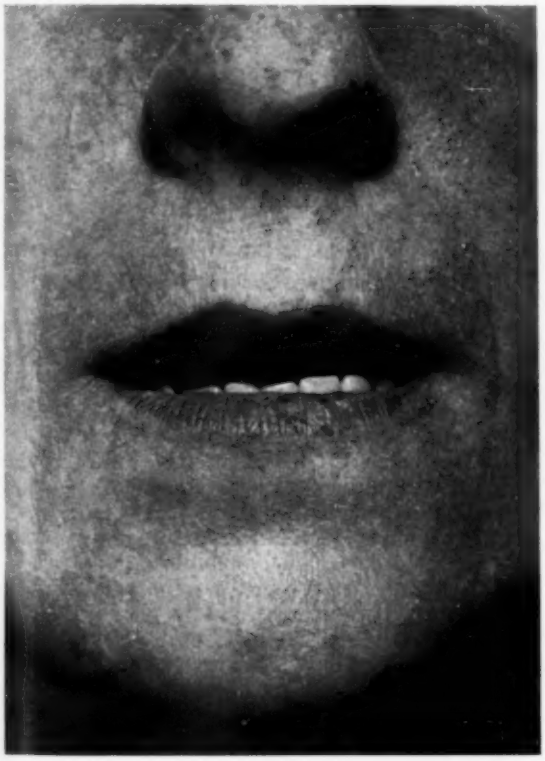

FIG. 444.—Showing the pigmented spots on the patient's lips.

FIG. 445.—Showing patches of pigmentation on the buccal mucosa.

The syndrome, as emphasized by Wolff, has three essential features :—

1. Pigmentation from birth or early childhood on the lips, face, and digits.

2. Multiple polyposis in the intestinal tract, always in the small intestine, and usually in the large intestine also.

3. A strong tendency to familial incidence.

CASE HISTORY

The patient, a married woman, aged 29, was admitted to the Rochford General Hospital on the morning of June 15, 1952, with a five-hour history of colicky pain in the right iliac fossa, accompanied by nausea and vomiting. Her bowels were opened with the onset of the pain.

She had apparently had a similar episode a fortnight before, when she had been admitted to a hospital elsewhere and was treated conservatively for a small-bowel obstruction. On that occasion she had ' settled down ' and was discharged from hospital one week after the acute attack.

Her previous history included ' operations for multiple polyposis ', one year and three years before, and an operation for intussusception 12 years before.

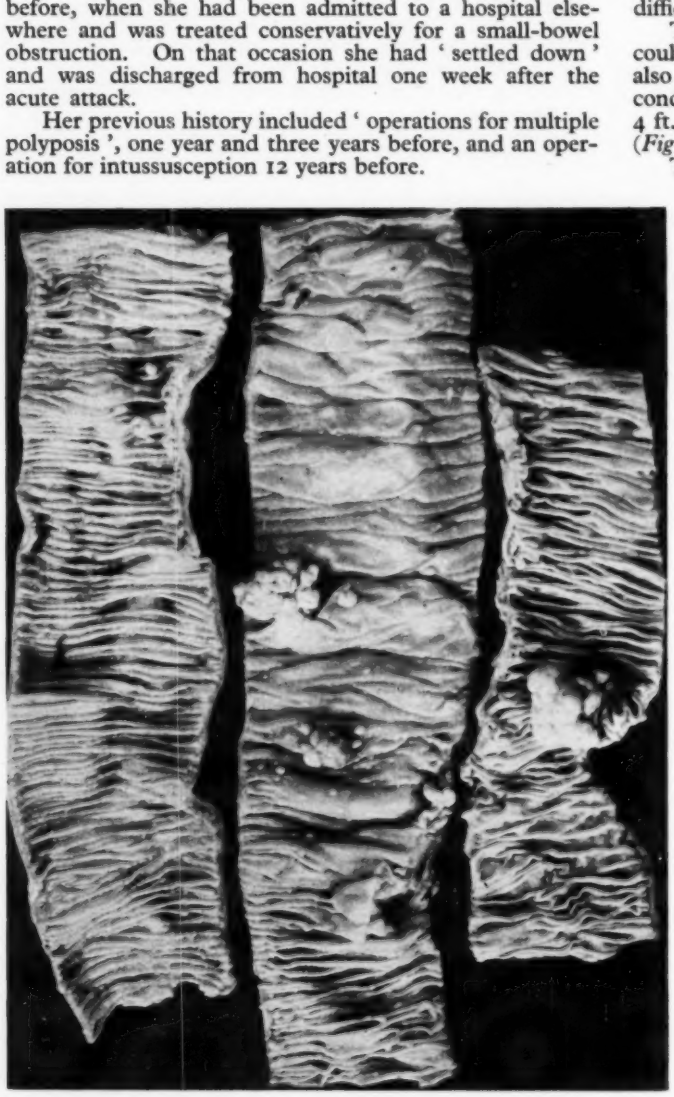

FIG. 446.—The resected portion of small intestine divided into thirds for mounting purposes, showing multiple polypi of varying size.

Regarding her family history, her mother and father were both alive, her father suffering with asthma ; she had two brothers and one sister alive and well.

ON EXAMINATION.—The patient was in obvious pain and when first seen she was sitting up in bed holding her abdomen, and having frequent spasms of colic in the lower abdomen. Her temperature was 99° F., pulse-rate 95, and respiration rate 20. Her tongue was clean and moist. There were brown pigmented spots on the mucous membrane of the lips and buccal cavity (*Figs.* 444, 445). There were lower paramedian and midline scars on the abdominal wall. There was generalized tenderness over the whole of the abdomen which was most marked in the right lower quadrant, where a large elongated firm mobile mass was palpable.

In view of the previous history and the sudden onset of pain on this occasion, considered with the findings on clinical examination, a provisional diagnosis of intussusception was made and an immediate laparotomy decided upon.

AT OPERATION.—The mass was found to be an ileo-ileal intussusception with approximately 18 in. of bowel ' intussuscepted '. This was reduced with some difficulty on account of adhesions at the neck.

The segment of bowel was œdematous, and polypi could be felt within the lumen. On this account, and also because of the obviously recurrent nature of the condition, the affected portion of the bowel, approximately 4 ft., was excised and end-to-end anastomosis performed (*Fig.* 446).

The patient was given two pints of blood post-operatively and prophylactic penicillin and streptomycin were administered.

PROGRESS.—She made an uninterrupted recovery and was discharged from hospital on the twelfth post-operative day.

PATHOLOGY.—The pathologist submitted the following report on the specimen :—

" The specimen consists of some 100 cm. of thickened, hypertrophied, small intestine. It is studded throughout its length with innumerable polypi, the majority of which are minute and measure a few millimetres in diameter. A few are of larger size, up to 3 cm. in diameter. The small growths are sessile, the larger tend to be pedunculated. Sections were taken from several of the larger growths. All are extremely active polypi, with numerous mitotic figures, and while not frankly malignant must be regarded as borderline tumours. One of the smaller growths, however, does show some invasion of its stroma and is even more active than the others. It must be regarded as an adenocarcinoma of the small intestine."

When seen four weeks after operation the patient was feeling well and was free from pain. Sigmoidoscopy was performed on this occasion and two adenomas were seen on the rectal wall 10 cm. from the anal margin.

DISCUSSION

Polypi are more commonly seen in the large than in the small bowel. Aitken and Brown (1948) were unable to find any figures for the *incidence* of polypi in the small intestine. They quote 4 to 6 per cent as published figures for the incidence of intestinal polypi found at autopsy, and also note that such tumours are more common in the large bowel. They consider that 30 per cent of these polypi become malignant, but again there are no figures for the likelihood of malignancy developing in similar small-bowel tumours.

The diagnosis of tumours of the small intestine is difficult as they are not readily visualized radiologically. Inevitably, then, the majority of such diagnoses are made at laparotomy, and often this is of an emergency nature, as emphasized by Beales and Frankel (1945).

However, the syndrome is a definite one, suggested by the occurrence of attacks of abdominal colic in one possessing the characteristic oral pigmentation. It is likely, indeed highly probable, that many of the cases of intestinal polyposis reported in the early literature were, in fact, examples of this syndrome in which the pigmented spots were not noted.

The familial nature of the condition has been stressed by most authors, including Perry and Zuska (1950), although they were describing an example with no family history. They reported their case as a sporadic instance of a syndrome which is usually hereditary and transmitted as a simple Mendelian dominant. There was no family history in our own

case, and it would appear that this is *not* an essential part of the syndrome.

TREATMENT

Polyposis of the colon is now accepted as a pre-malignant condition and radical treatment by total colectomy is the treatment of choice. The likelihood that polypi in the small intestine will become malignant is not so great as when these tumours occur in the colon.

Foster (1944) described small-intestine carcinomas occurring in father and daughter and presenting in similar fashion as intussusceptions. Although no figures are available, the interest that such a report provokes suggests its rarity.

Treatment of diffuse polyposis of the small intestine must remain expectant, active surgery being reserved for acute episodes of obstruction or the onset of intussusception. When, as in the case described above, there are polypi in the large bowel as well, the decision as to treatment becomes a much greater responsibility, and the question of total colectomy with permanent ileostomy must be considered.

SUMMARY

1. The syndrome of multiple intestinal polyposis, associated with a characteristic pigmentation around the oral cavity, as originally described by Peutz, is discussed.

2. A typical case, presenting as an emergency, is described, together with the operative and pathological findings.

3. Brief mention is made of treatment, considered to be largely expectant, with active surgery for acute episodes. This treatment would require revision in cases possessing polypi in the large bowel as well.

ADDENDUM

Since the above article was submitted for publication, four similar cases have been recorded, including 1 case by Basu (1952), 2 cases by Kitchin (1953), and 1 case by Kaplan and Feuchtwanger (1953). These 4 cases, together with the one reported here, make a total of 32 recorded cases of this syndrome.

I am indebted to Mr. Rodney Maingot for encouragement and advice in the preparation of this paper, and to Mr. B. J. Sanger, Surgical Consultant at Rochford General Hospital, for permission to publish this case.

The photographs were taken by Mr. J. Wood, medical photographer, Southend General Hospital, and to him also I wish to express my thanks.

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TRAUMATIC URÆMIA FOLLOWING HIGH FEMORAL OSTEOTOMY

REPORT OF A CASE

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DEATH from traumatic uræmia occurring within three days of high femoral osteotomy in a child adds to the dangerous nature of this area mentioned by Thompson and Mahoney (1951). The study of this case may also shed some light on our knowledge of muscle death and its consequences.

CASE REPORT

R. W., aged 12, reported with a flexion adduction contracture of the left hip, following osteomyelitis of the head of the femur at the age of 4.

An osteotomy was performed on April 26, 1951, in the coronal plane of the upper left femur, which was to be followed by traction in abduction in order to correct both his true and apparent shortening. After osteotomy (*Fig.* 447) he was fitted with a left Thomas splint incorporated in a short hip spica, with 10 lb. skeletal traction on the left tibia.

Sixteen hours after operation his pulse-rate suddenly rose and his blood-pressure fell to 70 milligrammes. His leg was warm and he was able to raise the leg off the slings of the Thomas splint. He was in no pain. The dressings were heavily blood-stained. A blood transfusion was established.

Nineteen hours: Patient still shocked. Good skin colour of the left leg and movements were present below the knee. The thigh was tense, but the distal pulses were palpable. Traction was released in view of the possible embarrassment of circulation by a hæmatoma in the thigh.

Twenty-four hours: The left foot was noticed to have assumed fixed equinus and there was no movement of the ankle or toes. There was complete sensory loss over the left leg below the knee, but the skin was of good colour and was warm. There was a brisk return of

FIG. 447.—Showing position of the osteotomy.

capillary circulation. All the encircling dressings were cut and the Thomas splint ring was cut. The skin was again of normal temperature and texture.

Twenty-seven hours: There was no change in sensation and in the degree of paralysis, but the skin

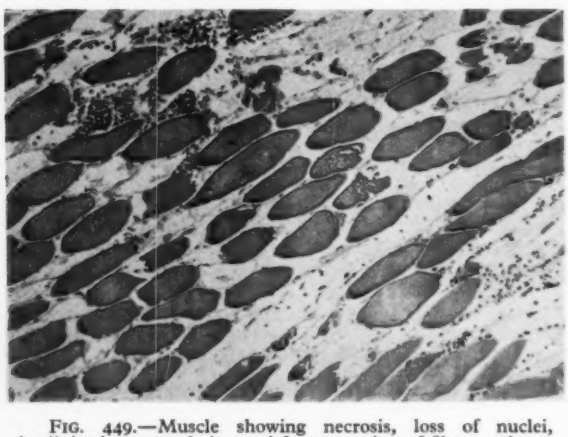

FIG. 449.—Muscle showing necrosis, loss of nuclei, hyalinization, vacuolation and fragmentation of fibres, œdema, and polymorphonuclear infiltration. (× 82·5.)

colour and temperature were still good. In view of this the wound was opened. No hæmatoma was discovered and the osteotomy site did not appear to be compressing any vessel. The wound was closed. It was now seen that the leg and foot were deathly white. In spite of continuous blood replacement his general condition was poor and exploration of the femoral artery was considered inadvisable.

Thirty hours: General condition fair. Foot and leg still cadaveric.

Thirty-two hours: Sudden return of skin colour. Foot was still cold but was now pink and gave a good return after capillary compression.

FIG. 448.—*Arteriogram performed post mortem.* A, Showing the bifurcation of the common femoral trunk with the limb in adduction; B, Showing occlusion of the profunda artery with the limb abducted at the osteotomy site.

Forty-four hours: General condition slightly worse. The tongue was furred and dry and the boy was eructating. Blood-pressure 120. The foot was still cold and

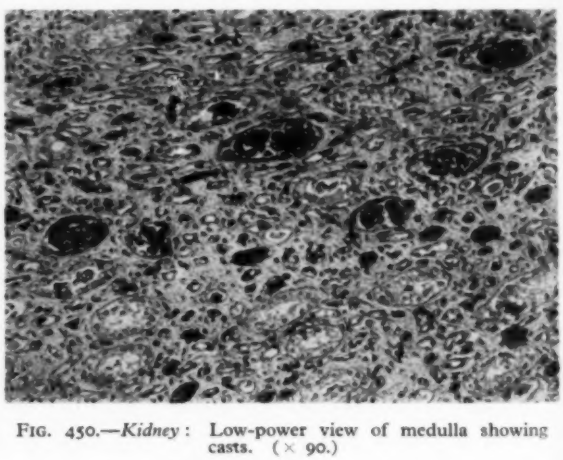

FIG. 450.—*Kidney*: Low-power view of medulla showing casts. (× 90.)

anæsthetic but of improved colour and the veins were filling from distal to proximal. He passed 8 oz. of urine, s.g. 1020, strongly acid, positive for albumin and giving a positive guiacum test, but with no cells. Up to now he had received 1½ pints of dextrose and 3 pints of cross-matched blood.

Fifty hours: Condition the same. Passed a further 5 oz. of clear brown urine. General hydration was fair and his tongue was moist.

Fifty-two hours: Sudden attack of intense pallor, with lip cyanosis and dyspnœa and right chest pain. He recovered in ten minutes with oxygen inhalations. No change in the condition of the leg.

Fifty-nine hours: Pulse fast and weaker. Skin and tongue dry. Blood-pressure unobtainable.

Sixty-four hours: Death.

ARTERIOGRAPHY.—Lipiodol was introduced into the left common iliac artery at post-mortem and with the leg in the neutral position this dye filled two femoral vessels. When the leg was abducted widely, the flow in both vessels was stopped, but in the degree of abduction at operation only one femoral vessel filled and, although it is impossible to mimic the state of affairs accurately, this examination suggested that the profunda artery was obstructed at the osteotomy site (*Fig.* 448).

PATHOLOGY.—The muscles of the left calf showed no gross abnormality to the naked eye. There was no œdema or swelling, but after a few hours in 10 per cent formalin large patches of pallor became apparent. The left femoral artery showed no evidence of injury.

Histologically there was extensive necrosis. The fibres, separated by some œdema fluid and a mild degree of polymorph infiltration, showed hyalinization, fragmentation, and granular opacity, the nuclei being either pyknotic or absent. Large areas of muscle showed these changes (*Fig.* 449).

The lungs showed subpleural hæmorrhages, patchy congestion, and œdema.

The kidneys were dark red in colour. On section there was slight eversion of the edges.

Kidneys: There were considerable changes in these organs, particularly in the ascending limbs of Henle and the distal convoluted tubules, but most parts of the nephron were affected. The capillaries of the glomeruli were bloodless and there was hyperplasia of the capsular epithelium at the point of exit of the proximal tubule. In many of the glomeruli there was eosinophilic material in the capsular space. Similar material is also seen in the lumina of the proximal convoluted tubules, but this tends to disappear as one descends the nephron and is rarely to be seen in the descending limbs of Henle. The proximal tubular epithelium shows cloudy swelling (*Fig.* 450).

In the ascending limbs and in the distal convoluted tubules damage out of all proportion to the foregoing was seen. The lining cells show all stages of nuclear degeneration from pyknosis to lysis, and there was vacuolation and patchy gross thinning of the cytoplasm. Occasional mitoses suggest the onset of regeneration. This was not marked, however. The lumina contained casts of varied appearance from a purple-staining hyaline mass, often seen in the ascending limb, to a coarsely granular eosinophilic deposit, usually seen in the distal convoluted tubule. Coarsely granular brown pigment casts were also seen, but these tend to occur in the collecting tubules and occasionally in the ascending limbs of Henle (*Fig.* 451).

The stroma was slightly œdematous. There was no appreciable cellular infiltration of fibroblastic proliferation.

Liver: In general this showed acute congestion, patchy fatty changes, and scattered necrotic foci which were paracentral in distribution; the foci of necrosis were quite small and measured about 400 μ in diameter. In them the liver cells were still present, but the nuclei

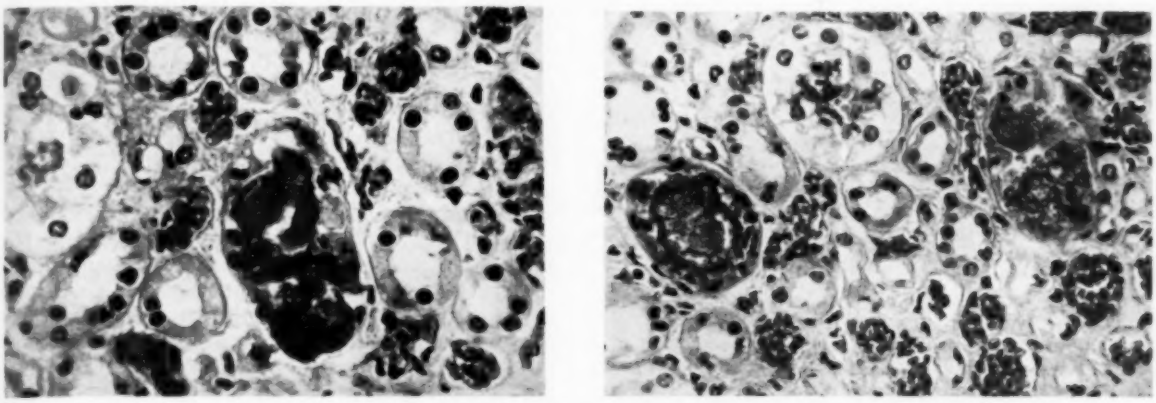

FIG. 451.—*Kidney*: High-power views of medulla showing granular and hyaline casts in degenerating tubules. (× 375.)

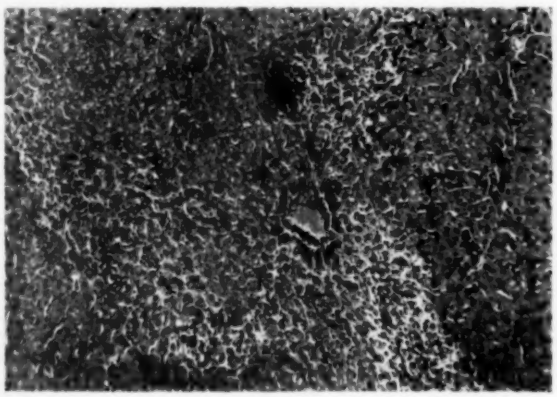

FIG. 452.—*Liver*: Foci of anoxic necrosis. (× 60.)

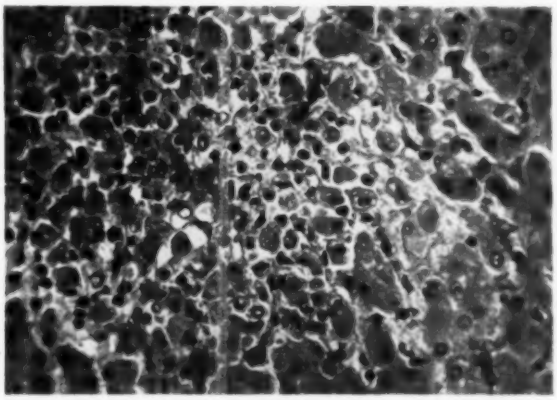

FIG. 453.—*Liver*: Anoxic focus showing vacuolated cells, degenerating cells, and histiocytes. (× 260.)

showed pyknosis and fragmentation. There was slight infiltration with polymorphs (*Figs.* 452, 453).

THE CAUSE OF DEATH.—The renal histology was typical of the early stages of a pigment nephrosis and is compatible with a duration of 2–3 days. The pigment could have originated from transfused blood, but there was no clinical evidence of incompatibility. The renal lesions produced, although severe, were too early to have caused death themselves, and death from crush syndrome as early as 3 days has not been reported. The degree of renal damage strongly suggests that some uræmia was present, and, had the patient survived the other factors, it is reasonable to suppose that the uræmia would in the natural course of such a nephrosis have increased and resulted in fatal renal failure.

Mallory (1947) states that in cases of hæmoglobinuric nephrosis, œdema, which is likely to be predominantly pulmonary and often develops with paroxysmal suddenness, frequently serves as the immediate cause of death, at any time from the third day on. The degree of pulmonary œdema present in our case is not such as would lead one readily to accept this as the explanation of death.

The focal necrosis in the liver, in the absence of any obvious infective lesion or other cause of toxæmia, is strongly suggestive of anoxia, from shock, with general hypotension and perhaps local arteriolar vasospasm. As with nephrosis, these lesions are compatible with an age of from two to three days, i.e., with an onset of shock shortly after operation. There is clinical evidence that shortly after the operation hæmorrhage and œdema occurred in the limb and the patient became very shocked.

Death appears, therefore, to have resulted from severe post-operative oligæmic shock associated with myoglobinuric nephrosis.

The post-mortem blood and C.S.F. urea levels were 194 and 198 mg. per 100 c.c. respectively, levels which are not raised sufficiently to attribute death to traumatic uræmia. The significance of the inability to find myoglobin in the urine is not clear. The post-mortem histology shows the presence of traumatic uræmia of a severe but not fatal degree, and it seems to be the combination of hæmorrhagic shock with traumatic uræmia that caused death in 3 days.

DISCUSSION

In trying to explain the nature of the ischæmia that produced the muscle death necessary for the fatality, the writers were impressed with several features. The foot first became paralysed and anæsthetic 20–24 hours after the operation. There was, however, no limb pain and the limb only became deathly white after 30 hours, and only remained in this cadaveric state for 3 hours. If change in skin colour be taken as essential to the diagnosis of total limb ischæmia, then the limb was only ischæmic for 3 hours. If this were traumatic uræmia it is doubtful at what stage the muscle bed became autolysed and at what stage the circulation had become adequate to effect a return of the products of autolysis to the kidney. If the cause had been femoral arterial occlusion occurring at the time of operation, then why was the sensory and motor paralysis so extensive when the peripheral circulation and temperature of the leg remained good for so long? It seems unlikely that the calf muscle paralysis was due to ischæmia of muscle, as in order to account for skin anæsthesia without skin ischæmia we must postulate a nerve-trunk lesion and not an end-organ lesion. This corroborates the work of Parkes (1944), and of Holmes, Highet, and Seddon (1944). The explanation which seems most acceptable to the writers is a period of muscle spasm in the profunda artery, the femoral artery itself only being involved after the exploration when the foot became deathly white. The evidence is that the operation was nearer the profunda artery and that it was shown arteriographically that full abduction occluded the profunda mechanically. It is suggested that the position at operation caused a spasm in the profunda vessel and this pathology gave rise to widespread muscle death in the thigh and ischæmic paralysis of the nerve-trunks. The profunda artery supplies the huge muscle bulk of the thigh, and its occlusion would cause necrosis of sufficient tissue to cause the renal changes. As the profunda only supplies muscles it is likely that its occlusion would go undetected until cessation of nerve function, its only sign, became obvious in the calf and foot. Our knowledge of vascular anatomy is incomplete but it would seem likely that the femoral artery must be patent if the skin of the foot is of good colour. The only missing feature is the peculiar twanging type of injury said by Trueta (1942) to be the commonest cause of arterial spasm. In the management of this case one is struck by the fact that any measures employed to save his limb will further endanger his life. Amputation as soon as the nerve lesion developed would probably have saved his life, but a step of this size at the time when it would have been beneficial would have required considerable bravery.

This case lacks many of the classical signs of total limb ischæmia so lucidly expounded by Griffiths (1948). There was no skin blistering, the foot and calf were not painful, and the skin colour of the foot and calf was for a long time normal although it was a paralysed and insensitive limb. There was no degree of muscle tension when the deep fascia of the calf was opened at post mortem. All these features were present in the cases described by Thompson and Mahoney (1951), where the lesion was in the femoral artery. This discrepancy has led the writers to postulate that the arterial lesion here was in the profunda artery mainly, and it is suggested that this differentiation of types of limb ischæmia has received inadequate attention.

SUMMARY

1. A case of traumatic uræmia causing death in three days is described.

2. Evidence is presented for the acceptance of a syndrome of profunda artery occlusion distinct in effects and prognosis from that of main artery occlusion.

Our thanks are due to Sir Harry Platt for permission to present this case.

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CONGENITAL ABSENCE OF PART OF THE COLON ASSOCIATED WITH CARCINOMA OF THE COLON

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CONGENITAL anomalies of the intestine are not uncommon, and many cases are described and discussed fully in the literature. The case recorded in this paper, however, is worthy of notice in that it illustrates the very rare abnormality of failure of differentiation of part of the colon: interest is added by the fact that it was discovered in an adult aged 32 years, and was associated with carcinoma of the colon.

CASE REPORT

HISTORY.—E. B., a female aged 32 years, admitted under the care of Mr. A. M. Clark, had had attacks of colicky abdominal pain for many years.

In the three weeks prior to admission the pains had become more marked and had been accompanied by vomiting: in the past few days the vomiting had become 'fæcal', the abdominal pain had become generalized and very severe, and complete constipation was present. In the past the patient had had no abdominal operations but had received treatment for congenital dislocation of both hips.

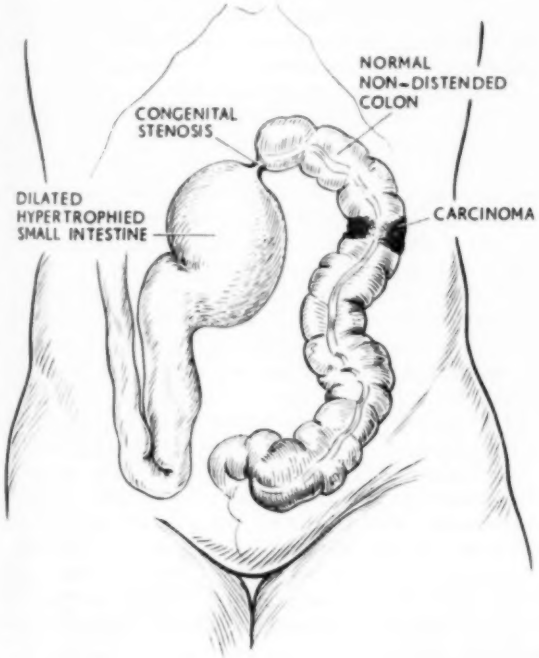

FIG. 454.—A drawing to illustrate the condition found at operation (full description in text).

PHYSICAL EXAMINATION.—The patient was a small, thin young woman with bilateral congenital dislocation of the hips and lumbar lordosis. Some degree of dehydration was present, and the patient looked ill and toxic, with a rapid pulse. The abdomen was markedly distended and tympanitic, especially in the upper left quadrant, where a diffuse swelling was palpable: generalized abdominal tenderness was found, but very little muscular guarding.

The remainder of the clinical examination (including rectal examination) was entirely negative.

A provisional diagnosis of acute intestinal obstruction (origin uncertain) was made, and immediate laparotomy undertaken.

AT OPERATION.—Left paramedian incision: on opening the peritoneum, it was found that the whole of the small intestine was very distended—the terminal loop of ileum measured approximately 4 in. in diameter and was hypertrophied. Instead of leading to the right iliac fossa, this loop of ileum passed to the left upper quadrant of the abdomen in the region of the splenic flexure. At this point the small intestine changed abruptly to normal non-distended colon, and the two portions of bowel were joined by a short very constricted segment ¾ in. long and ¼ in. in thickness, which had the appearance of a congenital stenosis and was the cause of the intestinal obstruction. A careful search showed no evidence of the cæcum, appendix, ascending colon, or proximal portion of transverse colon.

FIG. 455.—Post-operative radiograph of the abdomen after a barium enema: distal colon (distended with barium) lies to the right of the picture and small intestine (typical mucosal pattern) to the left; the anastomosis which connects the two is seen in the upper right corner.

About 3 in. distal to the commencement of the colon a small carcinoma was found of the 'string stricture' variety: the growth was mobile, and there was no evidence of metastases in the regional lymph-nodes or elsewhere. The carcinoma was not the cause of the obstruction, although its lumen was narrow. Some

calcified mesenteric lymph-nodes were present. (*Fig.* 454.)

Procedure.—Some difficulty was encountered owing to the gross bowel distension, the inaccessible position of the lesions near the splenic flexure, and the presence of several anomalous peritoneal folds and membranes. After mobilization, the affected portion of bowel was resected from a point just above the stenosis to well below the carcinoma. The ends were closed and continuity re-established by side-to-side anastomosis.

The patient progressed well and was discharged on the twenty-third post-operative day.

PATHOLOGICAL REPORT.—Naked eye: Portion of bowel 10 cm. long markedly narrowed by malignant tumour 3 cm. from one end. Tumour not obviously growing outside wall. Other end of colon narrow but no tumour seen there.

Histology: The tumour of colon is a mucoid carcinoma which has penetrated the muscle wall and is growing in the retrocolic fat.

The narrow end of the length of colon shows chronic ulceration of the mucosa with formation of granulation tissue. Plasma-cell infiltration is intense.

RADIOLOGICAL EXAMINATION.—Post-operative examination under the X-ray screen after barium meal confirmed the arrangement of bowel demonstrated at operation: barium passed to the rectum in 5 hours without obstruction.

Similar confirmation of operative findings was obtained after barium enema (*Fig.* 455). A chest radiograph showed no evidence of dextrocardia, etc.

DISCUSSION

A careful search at operation combined with subsequent radiological examination by barium series and barium enema has made the fact of congenital absence of the proximal colon beyond question. There is little doubt that the stenosis of the bowel was a congenital lesion with superadded inflammation rather than primarily due to inflammation (e.g. ' regional colitis '), volvulus, or malignant growth. The acute intestinal obstruction was certainly due to the stenosed segment of bowel, and the carcinoma of the colon was an accidental finding at operation. There was nothing in the pathological specimen to suggest the presence of an ' ileocæcal ' valve.

Nature of the Lesion.—According to classical descriptions of the development of the intestinal tract (Dott, 1923), the midgut becomes prolapsed into the umbilical cord as a ' physiological hernia ' about the fourth week of embryonic life: at this stage of development the midgut is subdivided by the presence of the vitelline (later superior mesenteric) artery into ' pre-arterial ' and ' post-arterial ' limbs: traced to its adult status the post-arterial limb of the midgut is found to become transformed into the following structures: terminal ileum, cæcum and appendix, ascending colon, and (approximately) the right two-thirds of the transverse colon. These are the precise structures which were found to be absent in the case under discussion. The conclusion to be drawn would therefore seem to be that the post-arterial limb of the midgut loop had failed to differentiate *in toto*, and is represented in this case by the stenosed segment of bowel which was found connecting the small intestine (which had developed normally from the pre-arterial limb of the midgut) with the distal colon (which had developed normally from the hind gut).

The history of years of colicky pains, and the presence of hypertrophied small intestine indicate that partial intestinal obstruction had been present over a long period, probably since fœtal life. The histological report on the stenosed portion of bowel shows that this had become (as might be expected) the site of chronic inflammation, and it is reasonable to assume that this brought about further narrowing of this segment and finally precipitated complete obstruction. There was no evidence here of tuberculosis.

The association with carcinoma of the colon is of particular interest. In view of the patient's youth it seems unlikely to have been merely a matter of chance, and the circumstance savours of Cohnheim's theory of cell rests.

The presence of bilateral congenital dislocation of the hips was a subtle pre-operative hint as to the possible cause of intestinal obstruction, and illustrates the well-known fact that congenital abnormalities are often multiple.

The Rarity of the Lesion.—The more common congenital lesions of the large intestine are anomalies of rotation and peritoneal attachments, megacolon and microcolon, of which there are many recorded cases. A survey of the literature in the last 40 years shows that obstruction of the colon by intrinsic congenital lesions is rare. For instance, Farr and Brunkow (1925) estimate the incidence of all intestinal tract congenital obstructions (excluding imperforate anus) as 1 in 20,000 births—of which only 10 per cent of the total occur in the colon.

Stenosis, atresia, and absence of part or whole of the colon are the least common congenital lesions. Heckel and Apfelbach (1927) published a series of cases collected from the literature showing 30 cases of atresia, and a segment of intestine was absent in 24 of these cases: how many of these showed absence of part of the colon could not be ascertained, but it was probably a small number. Since 1926 about 25 cases of congenital atresia or stenosis in the colon have been reported, but I have not succeeded in finding a case where a segment of colon was absent.

Haxton (1945) has reported finding a congenital break in continuity between small and large intestine in a 2-day-old infant.

Sheinfeld (1950) has described a case of congenital abnormality of the pelvic colon associated with carcinoma of the cæcum and this was dealt with by immediate resection as in the present case. This is the only case I have found where a congenital lesion of colon has been associated with carcinoma of colon.

SUMMARY

A case is described of congenital absence of the proximal colon with stenosis causing acute intestinal obstruction in an adult aged 32 years and associated with mucoid carcinoma in the distal colon.

My thanks are due to Mr. A. M. Clark, Glasgow Royal Infirmary, for permission to publish these notes; and to Professor C. F. W. Illingworth, Glasgow University, for helpful criticism.

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THE DIAGNOSIS OF SYNOVIAL TUBERCULOSIS OF THE HAND AND WRIST BY EPITROCHLEAR GLAND BIOPSY

BY SIMON SEVITT

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PRIMARY tuberculous disease of the lymph-glands of the upper or lower limbs is exceptional; that is to say, tuberculosis of the axillary, epitrochlear, inguinal, or popliteal lymph-nodes as part of a generalized tuberculous adenitis with or without pulmonary or other organ tuberculosis occurs but rarely. However, secondary tuberculosis of the lymph-glands draining a tuberculous focus is common; for example the inguinal glands of the same limb in a patient with tuberculosis of the knee are usually enlarged and tuberculous.

Although this secondary tuberculosis of the lymph-glands has been known for many years, the *biopsy* of a regional lymph-gland as an aid to the diagnosis of tuberculosis in its drainage area was not described until 1933 when Valls published an account of inguinal gland biopsy as an aid to the diagnosis of knee and ankle tuberculosis. In this country inguinal gland biopsy was described in 1939 by Seddon. In his series of eighteen patients with tuberculosis of the knee joint, the ipsilateral inguinal glands in fifteen patients were found to be tuberculous.

PRESENT SERIES

Tuberculous infection of the synovial membranes of the hand and wrist is not an uncommon condition. Sometimes the clinical diagnosis is easy and sometimes difficulties arise. The condition may be atypical, for example affecting the extensor rather than the flexor tendons; other swellings of the fingers, hand, or wrist may be difficult to distinguish from the swellings of tuberculous bursæ, and occasionally a secondary pyogenic infection complicates the tuberculous disease and makes the diagnosis of tuberculosis difficult.

To overcome these difficulties it was decided to try epitrochlear lymph-gland biopsy as an aid to diagnosis. The epitrochlear gland is always enlarged in tuberculous disease of the hand and wrist and usually palpable, but excess fat around the elbow may make it difficult to feel. However, the gland is commonly enlarged and palpable in other chronic synovial swellings of the hand and wrist, so that enlargement itself is not a diagnostic feature.

Theoretically the removal of the gland might produce a tuberculous sinus at the elbow; however, the tuberculous glands were found to be firm, macroscopic caseation was absent, the glands were removed intact and surrounded by subcutaneous tissue, and the small skin incisions healed by first intention.

Biopsy Technique.—A small incision was made above the medial epicondyle under local anæsthesia. The gland, surrounded by subcutaneous fat, was bluntly dissected free and placed in a *dry* sterile container.

Laboratory Methods.—The gland was placed in a sterile Petri dish and divided into two parts with a sterile scalpel.

From one or both halves smears were made on sterile slides, fixed in methyl alcohol, and stained by the Ziehl-Neelsen method. One half of the gland was then fixed in formol saline and paraffin sections were prepared. These were stained in the usual routine way, including a Ziehl-Neelsen preparation.

The other half of the gland was placed in a small sterile mortar; about 1 c.c. of sterile saline was added and the gland was ground up to a turbid suspension. Part of this was inoculated on to two or more Lowenstein-Jensen slopes. If indicated, routine blood-agar and Robertson's cooked-meat media were also inoculated. The remainder of the fluid was injected into a guinea-pig's thigh. Identification of growth of tubercle bacilli and guinea-pig tuberculosis was made by the standard methods.

RESULTS

(*Table I.*)

Eight patients (*Cases* 1–8) presenting swellings of bursæ of the hand or wrist underwent epitrochlear gland biopsy. All of these patients were operated on at a later date when the swellings were removed. The histology of the excised tissue, often with bacteriological investigation for tubercle bacilli, was carried out. On every occasion the diagnosis arrived at by epitrochlear gland biopsy was confirmed when the tissue was examined. In all the seven patients with synovial tuberculosis (*Cases* 1–7), the epitrochlear lymph-glands had shown histologically a hyperplastic, multifollicular type of tuberculosis with little or no caseation and acid-alcohol fast bacilli were found in five of the sections. In the eighth patient the epitrochlear gland was not tuberculous and the histology of the thickened synovia of the wrist was also non-tuberculous (*Case* 8).

We can, therefore, conclude that ordinary histological examination of the excised epitrochlear gland is itself a most helpful diagnostic method for or against synovial tuberculosis of the hand and wrist.

Direct smears stained by the Ziehl-Neelsen method were made from four glands which later proved to be tuberculous. In two, acid-alcohol-fast bacilli were found. If positive by the Ziehl-Neelsen

method a gland smear is therefore the most rapid diagnostic method. A negative result of course is not significant.

Bacteriological culture for tubercle bacilli and/or guinea-pig inoculation tests were carried out on the seven glands which histologically showed tuberculous granulation tissue. Six of these were positive for tubercle bacilli, but the seventh gland (*Case* 3) was negative to both tests, even though gland smears non-tuberculous. Subsequently the skin nodule was excised and proved on histology to be a granuloma pyogenicum.

SUMMARY

Eight cases are presented in which epitrochlear lymph-gland biopsy was performed as an aid to the diagnosis of synovial tuberculosis of the hand and wrist.

Table I.—CORRELATION OF EPITROCHLEAR GLAND AND SYNOVIAL TISSUE

Case No.	Lymph-gland					Synovial Tissue	
		Histology		*Tubercle Bacilli*			
	Gland Smear for A.F.B.	Structure	A.F.B.* in Section	Culture	G.P. Test†	*Histological Diagnosis*	*T.B. Culture and/or G.P. Test†*
1	+	Tuberculous	+		+	Tuberculous	
2‡	−	Tuberculous	+	+	+	Tuberculous + secondary infection	+
3	+ +	Tuberculous	+	−	−	Tuberculous	+
4		Tuberculous	+	+		Tuberculous	+
5	−	Tuberculous	−	+	+	Tuberculous	+
6		Tuberculous	+	+		Tuberculous	
7		Tuberculous	−	+	+	Tuberculous	+
8		Non-tuberculous	−			Non-tuberculous	
9		Non-tuberculous (axillary gland)	Two Other Cases			Final Diagnosis Granuloma pyogenicum	
10		Tuberculous	+	+	+	Tuberculosis of the elbow	

* A.F.B. = Acid-alcohol-fast bacilli morphologically resembling tubercle bacilli.

† G.P. test = Guinea-pig inoculation test for tubercle bacilli. ‡ *Staph. aureus* also cultured from lymph-gland and synovial tissue.

had previously shown numbers of acid-alcohol-fast bacilli. The diagnosis of tuberculosis might have been questioned had the gland not been sectioned.

Similar experience is reported by Seddon (1939) and Valls (1933). Seddon, for example, mentions that although the one half of each of two inguinal glands infected guinea-pigs with tuberculosis, the other halves of the glands showed no evidence of tuberculous histology. This is the converse of the experience in *Case* 3, but the explanation offered by Seddon that only one part of the gland was tuberculous whilst the remainder was normal would explain both types of anomaly.

In addition to the patients with bursal disease, glands from two other patients were examined. One (*Case* 10) presented a difficult clinical and radiological picture of the elbow. The palpable epitrochlear gland was excised: the histology was that of tuberculosis; tubercle bacilli were later isolated by cultural methods from the gland and the inoculated guinea-pig became tuberculous. The elbow disease was consequently diagnosed as tuberculosis and this was later confirmed radiologically.

Another patient presented a red swelling of the skin on the back of the hand. Tuberculosis was considered possible but improbable; an enlarged axillary gland was excised the histology of which was

In seven patients the histological diagnosis of tuberculosis made from the gland histology was confirmed by later examination of the excised synovial tissue. In another patient both gland and tissue were non-tuberculous. Although the series is small, the consistent findings indicate the value of the technique.

Diagnosis by histology, which can be carried out within 48 hours, is recommended as a reliable method.

Direct smears of the glands stained for tubercle bacilli may yield rapid positive results in some cases. Cultural methods for tubercle bacilli and/or guinea-pig inoculation tests should also be performed to circumvent the possibility that only one part of the divided lymph-gland is tuberculous.

I wish to thank my surgical colleagues of the Birmingham Accident Hospital, in particular the Clinical Director. Mr. W. Gissane, for allowing me to use their case records and for their active interest and kind co-operation.

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EXCISION OF THE SUPERIOR RAMUS OF THE PUBIS FOR LARGE OSTEOCHONDROMA

By F. G. ST. CLAIR STRANGE, Canterbury

Partial excisions of the pelvis for large osteochondromata are rarely practicable, and this is even truer when the condition is known to be frankly malignant. But when the fortunate situation of the tumour permits the hope that a local resection may be complete, it is obviously preferable to hindquarter amputation. The case reported here resembles in some respects that recently recorded in this journal by Muir (1951).

Fig. 456.—Photographs of tumour taken at operation.

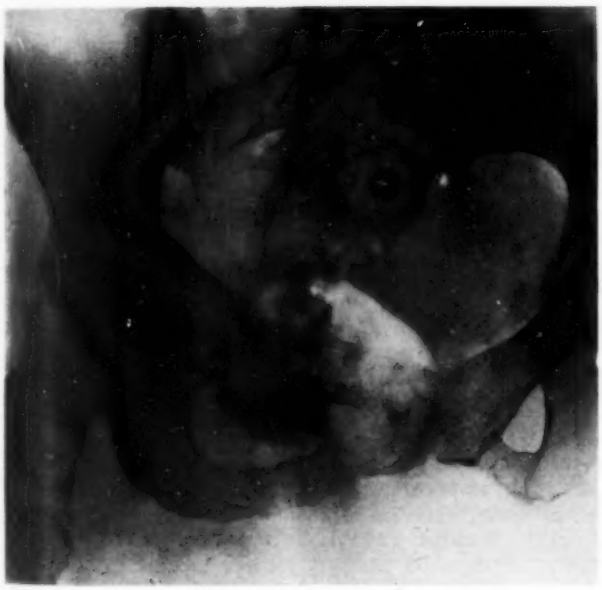

Fig. 457.—Oblique radiograph of pelvis, showing tumour arising from centre of right superior pubic ramus.

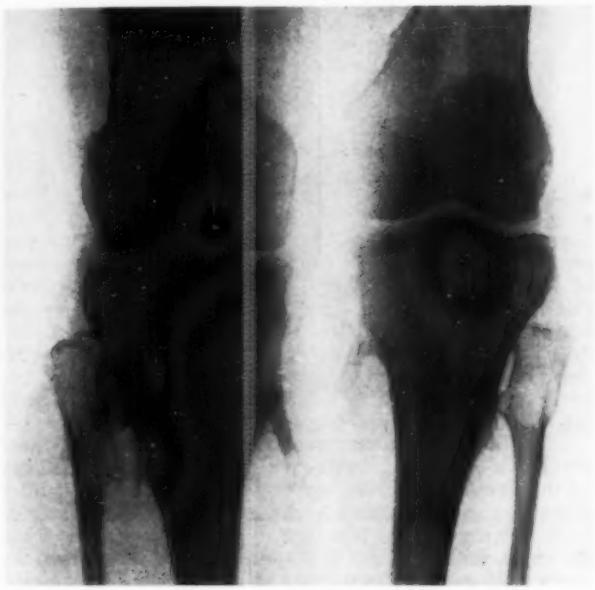

Fig. 458.—Anteroposterior radiograph of knees, showing typical appearances of diaphysial aclasis.

CASE REPORT

History.—Mrs. P., aged 40, had noticed a swelling in the right groin for seven months, and this had got considerably larger during the last three months. There was some pain on walking, and lately there had been some swelling of the leg. She was otherwise well, and had not lost weight.

On Examination.—The patient was a fit, well-covered lady with obvious diaphysial aclasis, exostoses being palpable on the left humerus and on both knees. There was a hard swelling in the right groin projecting forwards below the inguinal ligament. It was fixed to the pubis and felt to be about 4 in. (10 cm.) in diameter, though it was slightly lobulated (*Fig.* 456). The femoral artery could be felt on the lateral side of the tumour. There were a few small dilated veins in the vicinity, but the skin moved freely over the swelling and was not thinned or reddened. There was slight restriction of the extremes of hip range and some œdema of the leg.

Radiographs (*Fig.* 457) showed a partly bony tumour arising from the front of the middle of the horizontal ramus of the pubis, and confirmed the presence of diaphysial aclasis (*Fig.* 458). It was decided that the tumour should be removed as the possibility of malignant change could not be ruled out. In view of the situation of the swelling, an attempt at local resection was considered reasonable.

AT OPERATION (Feb. 14, 1951).—A U-shaped incision was made from above and lateral to the anterior

FIG. 459.—Post-operative radiograph showing area of bone excised.

superior iliac spine, curving down onto the thigh and up over the pubic crest to a point above and to the left of the symphysis pubis. A vertical 'stem' was added to give more room inferiorly. In order to avoid the development of a hernia into the thigh, a large fascia lata flap was fashioned with its base attached to the outer half of the inguinal ligament. After reflection of this and the detachment of both ends of the ligament, together with the rectus sheath and origin of the right rectus, the peritoneum and bladder were separated from the back of the superior ramus and os pubis.

The adductors, except adductor magnus, were now divided 2 in. (5 cm.) below the tumour and the cartilage of the symphysis in its upper two-thirds incised under direct vision with a knife. An oblique osteotomy of the body of the pubis into the obturator foramen freed the inner end, but to get at the outer end of the ramus, the psoas (but not the iliacus) had to be divided. Retraction of the vessels now allowed an osteotome to be passed very obliquely backwards and inwards in front of the hip-joint, which was considerably overhung by the tumour, and thus to section the outer end of the superior ramus. Division of the upper halves of the obturator muscles and the insertion of pectineus allowed the tumour to be removed.

The wound was closed after suturing the fascial flap to the remains of the cartilage of the symphysis and the 'white line' of fascia over the intact part of obturator internus.

Convalescence was slow, as there was a great outpouring of lymph from the wound, and a certain amount of soft-tissue infection followed, though the wound was soundly healed in five weeks. Flexion at the hip remained weak as a result of division of the psoas—iliacus, sartorius, and tensor fascia lata proving unable to act to a power greater than 3 (M.R.C. rating).

The patient was seen on July 4, 1953, when there was no clinical or radiological evidence of recurrence, either locally or in the lungs (*Fig.* 459). She could walk slowly without sticks and without a limp, but her power of hip flexion remained no more than a good value of 3. There was no scoliosis. There was no hernia.

PATHOLOGY.—The tumour was encapsulated, smoothly lobulated, and measured 10 cm. in diameter (*Fig.* 460). It was largely composed of glistening blue cartilage with

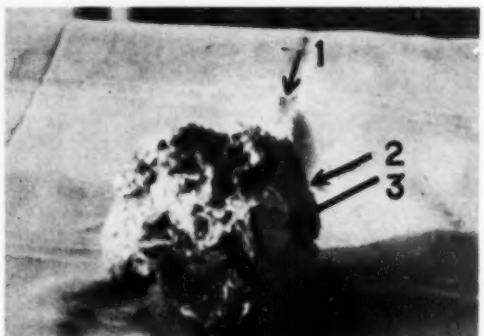

FIG. 460.—Tumour in the vertical position seen from the medial aspect after removal. Arrows show: (1) Lateral end of pubic ramus. (2) Upper part of obturator internus arising from back of middle of pubic ramus. (3) The upper two-thirds of the right os pubis, with its covering cartilage of the symphysis.

some radiating bony spicules within it. The histology was that of an osteochondroma, with no definite evidence of malignant change in the zones examined. The rapid enlargement of the tumour in recent months leads one to suspect that there was probably the threat, if no more, of malignant changes developing.

DISCUSSION

The site of this tumour gave the opportunity to remove it locally with the whole thickness of the bone from which it was arising, an unusual chance to seize, as such a procedure would generally mean the destruction of the continuity of the bony framework of the part. The only possible alternative would have been a hind-quarter amputation.

Prior to the operation, no previous descriptions of such a procedure had been encountered, but since then, references have been traced to Krook (1938), Stewart (1909), and Dinan (1939). With the exception of Stewart's case, all these were for the treatment of osteomyelitis of the pubis. Stewart removed the pubis bilaterally for a spindle-celled sarcoma lying behind it with success. Since the operation was performed, Muir (1951) has reported the successful removal of the whole os pubis for sarcoma. The case here recorded seems to be the first in which the superior ramus alone has been removed for new growth, for which one must be grateful to the fortunate chance that placed the tumour almost exactly in its centre.

One had often wondered whether a paralysed psoas might play a part in the development of a local lumbar scoliosis. In this patient it is known

that the psoas has been divided, and therefore its pull on the lumbar vertebræ is negligible. Nevertheless, some nine months after the operation, no sign of a scoliosis is present, and this has been confirmed by taking radiographs in the erect posture.

The only comment on the operative technique that needs to be brought forward is that, on a future occasion, one would repair the psoas muscle. It was thought mistakenly that the other hip flexors were capable of taking over its work to a satisfactory degree, but this has not been the case.

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FERROUS SULPHATE POISONING CAUSING PYLORIC OBSTRUCTION*

BY ISABELLA FORSHALL and P. P. RICKHAM, LIVERPOOL

NUMEROUS reports of ferrous sulphate poisoning in children have been published in the last few years. The Royal Liverpool Children's Hospital and Alder Hey are the two major children's hospitals on Merseyside; during 1950–51, 12 children suffering from ferrous sulphate poisoning were seen at these hospitals.

Pyloric obstruction following the ingestion of caustics is a well-known complication; it has not, however, been recorded after ferrous sulphate poisoning. The two following cases in which the history and clinical, radiological, and operative findings were very similar are considered of sufficient interest to justify record.

CASE REPORTS

Case 1.—Marjorie H., 17 months of age, was admitted to Alder Hey Children's Hospital on May 28, 1949. Forty-eight hours previously she had swallowed between ten and fifteen Fersolate tablets. Following this accident she was 'off colour', refused to swallow solids, and screamed at night with abdominal pain. She had vomited four times shortly before admission; the last vomitus had contained black material.

On examination she was pale and apathetic; her pulse was 140 and of poor volume. Nothing abnormal was discovered on clinical examination. There were no petechiæ and the liver and spleen were not palpable. The bleeding time was 2 minutes and the hæmoglobin 98 per cent. She vomited fresh blood twice on the evening of admission and a blood transfusion was given. The next day (May 29) she had five more hæmatemeses and a further 300 c.c. of blood were transfused, after which her condition improved. Oral feeding was started, glucose-saline being given initially and then iced milk. On May 30 her general condition was satisfactory; hæmoglobin 101 per cent, but she continued to vomit brown material which gave a strongly positive reaction for blood and a weak positive reaction for ferrous iron. Vomiting slowly subsided and by June 1 she was taking a light diet. She made a satisfactory recovery and was discharged quite fit on June 10, no vomiting having occurred for ten days.

She was re-admitted on July 13 with the history that after discharge from hospital she had at first vomited once daily. During the week preceding re-admission, the frequency of the vomiting, which had no definite relationship to food, had increased to 2–3 times a day. The mother had noticed 'waves' passing over the abdomen from left to right.

ON EXAMINATION.—She was a thin, ill, dehydrated child; the tongue was furred and dry. There was marked fullness in the epigastric region and large peristaltic waves were seen crossing from the left costal margin towards the right hypogastrium. X-ray examination after a barium meal showed a grossly dilated stomach; after six hours only a trickle of barium had passed the pylorus (*Fig.* 461). It was feared that the barium would completely obstruct the pylorus and the stomach was therefore washed out; nevertheless, there was still barium in the stomach 24 hours later. The child was

FIG. 461.—Radiograph of stomach three hours after ingestion of barium meal. The stomach empties slowly, the barium trickling through the narrow pyloric channel. *Case* 1.

put on continuous gastric suction and intravenous infusion of half-strength plasma.

AT OPERATION (July 15).—The peritoneal cavity was entered through a midline supra-umbilical incision. The stomach was found to be dilated and thick walled; the pylorus was normal in appearance, but palpation gave the impression of thickening of the walls of the pyloric canal. Incision of the pyloric antrum anteriorly showed the gastric mucosa to be thick and œdematous and the pyloric canal grossly stenosed, only admitting a fine probe; no area of scarring of the mucosa of the pyloric antrum was identified. A posterior no-loop gastro-jejunostomy was performed.

Post-operatively the child was put on continuous gastric suction and intravenous glucose-saline infusion

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for 48 hours; feeding was started on the third post-operative day. A barium meal on Aug. 18 showed reduction in the size of the stomach and rapid emptying into the jejunal loop. The child was discharged on Sept. 10, at which time there was still a marked degree of epigastric distension.

She was followed up in the out-patient department, her abdominal distension gradually disappeared, and although she has remained thin and small (she was 54½ in. tall and weighed 30 lb. at 4 years of age) she has enjoyed good health, eats well, and is not constipated.

Case 2.—James M., 13 months of age, was admitted to the Royal Liverpool Children's Hospital on Jan. 13, 1952; he had swallowed an unknown number of

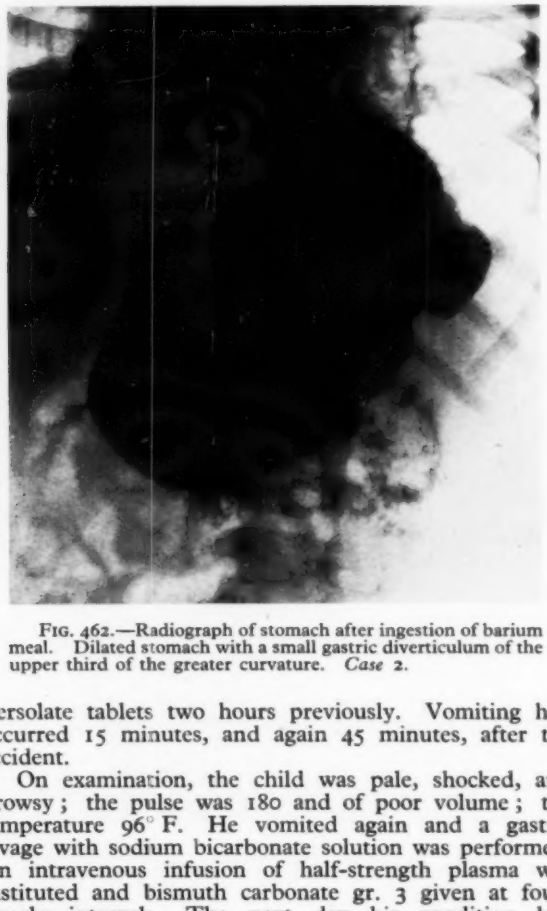

FIG. 462.—Radiograph of stomach after ingestion of barium meal. Dilated stomach with a small gastric diverticulum of the upper third of the greater curvature. *Case* 2.

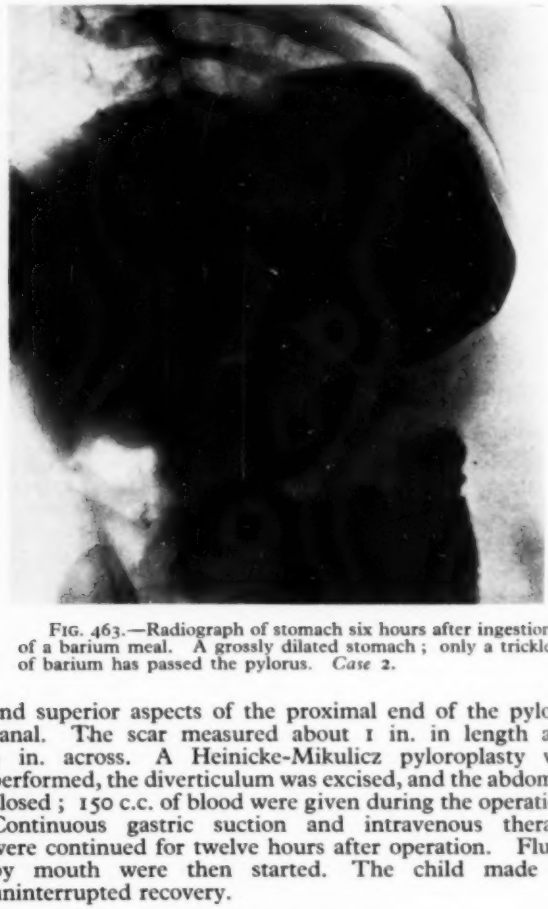

FIG. 463.—Radiograph of stomach six hours after ingestion of a barium meal. A grossly dilated stomach; only a trickle of barium has passed the pylorus. *Case* 2.

Fersolate tablets two hours previously. Vomiting had occurred 15 minutes, and again 45 minutes, after the accident.

On examination, the child was pale, shocked, and drowsy; the pulse was 180 and of poor volume; the temperature 96° F. He vomited again and a gastric lavage with sodium bicarbonate solution was performed. An intravenous infusion of half-strength plasma was instituted and bismuth carbonate gr. 3 given at four-hourly intervals. The next day his condition had improved and there had been no further vomiting. There was vague tenderness over the epigastrium; the liver was not clinically enlarged. On Jan. 15 oral feeds were started; he vomited again once the next day. The intravenous infusion was discontinued on Jan. 17 as there was no further vomiting and the child was taking satisfactorily by mouth. He was discharged home on Feb. 1.

James was re-admitted on Feb. 5 with the history of having vomited after every feed since his discharge from hospital. The general condition was quite good and there was no dehydration. The child took feeds well but had several attacks of vomiting during the next few days. On Feb. 13 a barium meal was given and the child was screened; the barium passed rapidly into the stomach, which was of normal size. There was a small gastric diverticulum of the upper third of the greater curvature (*Fig.* 462). The stomach emptied very slowly, the barium trickling through a much narrowed pyloric channel (*Fig.* 463); there was still barium in the stomach after eight hours. On Feb. 20 a test feed was given and gastric peristaltic waves were seen crossing the epigastrium.

AT OPERATION (Feb. 27).—The peritoneal cavity was entered through a supra-umbilical transverse incision. The stomach was found to be dilated but its walls were not thickened; the pylorus looked normal, but its walls were definitely thickened to palpation. There was a small diverticulum, 1 in. in diameter about two-thirds up the greater curvature. A longitudinal incision was made along the anterior aspect of the pyloric antrum; a small probe could just be passed through the narrowed pylorus. It was seen that the pylorus was obstructed by the scar of a healed ulcer situated on the inferior, posterior, and superior aspects of the proximal end of the pyloric canal. The scar measured about 1 in. in length and ¼ in. across. A Heinicke-Mikulicz pyloroplasty was performed, the diverticulum was excised, and the abdomen closed; 150 c.c. of blood were given during the operation. Continuous gastric suction and intravenous therapy were continued for twelve hours after operation. Fluids by mouth were then started. The child made an uninterrupted recovery.

DISCUSSION

Since Forbes (1947) and Thomsen (1947) each reported the death of a child following the ingestion of ferrous sulphate tablets, there have been many reports of ferrous sulphate poisoning in British and American journals.

The clinical picture of the acute phase of ferrous sulphate poisoning in children is now well known. Pallor, tachycardia, retching, vomiting, drowsiness, listlessness, cold clammy skin, often hæmatemesis and sometimes diarrhœa, the stools being either bloody or clear, have been described by many pædiatricians. Spencer (1951) stressed the point that symptoms may not appear for 24 hours after swallowing the poison, collapse being delayed. A number of necropsy findings have been described

in the literature; the stomach is most often affected and the small intestine less frequently. The mucosa is œdematous and congested and there are many hæmorrhagic and necrotic areas. These changes have been explained by Swift, Cefalu, and Rubell (1952) as follows: The caustic effect of the iron produces mucosal necrosis; this destroys the tissue barrier to iron absorption and permits chemically unaltered ferrous sulphate to gain entry into the veins and lymphatics, and causes thrombosis and gangrene.

There has been some disagreement as to the cause of death in these children. Prain (1949) has advanced the theory that death is caused by liver failure, but this is not substantiated or generally accepted.

Pyloric obstruction following the swallowing of corrosives is not uncommon. The first case was reported by Robert in 1828 and Strode and Dean (1950) collected 150 cases from the literature. Gray and Holmes (1948) in a comprehensive article listed the following chemicals as causes of pyloric stenosis: hydrochloric acid, sulphuric acid, nitric acid, trichloracetic acid, carbolic acid, zinc chloride, copper-sulphate, potash, and formaldehyde. McLanahan (1934) described a case caused by tincture of iodine.

In only 6·5 per cent of the 139 cases reviewed by Gray and Holmes (1948) was there a concommitant œsophageal stenosis. It is noteworthy how often the pyloric antrum and the pylorus are the only areas affected by the ingested caustic. This is explained by the rapid transit of ingested fluids along the *Magenstrasse* of the stomach (Waldeyer, 1908). Schulenburg (1941) quotes Testa (1938), who added caustic soda to a barium mixture and fed it to experimental animals, following the progress of this mixture under the X-ray screen. The fluid passed quickly down the œsophagus and along the *Magenstrasse* and was held up in the pyloric antrum by firm spasm of the pylorus. Subsequent necropsy showed that the trauma to gastric mucosa was confined to the pyloric area.

In cases of pyloric obstruction following the ingestion of caustics symptoms do not manifest themselves until between ten days and six weeks after the accident (Schulenburg, 1941). Presumably the fibrosis and narrowing of the pylorus caused by healing of the traumatic ulcer becomes severe enough to produce symptoms only after this period has elapsed. The two cases reported in this paper show a time lag within these limits (46 and 23 days respectively).

In our first case we did not slit open the pyloric antrum and pyloric canal and could therefore not see the ulcer scar which caused the obstruction. The scar of the ulcer was clearly demonstrated in the second patient.

Milroy Paul (1951), in discussing the treatment of pyloric obstruction following corrosive poisoning, states that although partial gastrectomy has been advocated, only 4 of the cases reported in the literature have in fact been treated by this operation. The majority of patients have had a gastro-enterostomy performed, with excellent results. The first case in which a successful gastro-enterostomy was performed for pyloric stenosis due to a corrosive was in 1884 when Monastyrski successfully treated a 36-year-old woman who had ingested sulphuric acid. As children under 5 years do not stand partial gastrectomy well, a gastro-enterostomy was performed on our first patient. In the second child we widely opened the pyloric antrum and pyloric canal in order to inspect the mucosal lining and it then became obvious that a Mikulicz pyloroplasty could easily be performed. Pyloroplasty has been criticized as a treatment of pyloric stenosis secondary to corrosive poisoning, but several successes are reported in the literature, amongst them the first successful pyloroplasty ever to be performed by von Mikulicz in 1888 on a 20-year-old girl who gave a history of having drunk large quantities of vinegar many years previously.

The presence of a gastric diverticulum in the second patient raises the question if this was an incidental finding or secondary to the pyloric obstruction. Only 8 cases of gastric diverticula in infancy have been described in the literature. Ogur and Kolarsic (1951) reported a child of 9 weeks of age with congenital pyloric stenosis; at operation a wide diverticulum on the lesser curvature, 1 cm. proximal to the pylorus, was found. This was regarded as a pulsion diverticulum secondary to an obstruction of nine weeks' duration. In our case the site of the diverticulum and its histological appearance are in favour of a congenital origin.

SUMMARY

Two cases of pyloric stenosis in young children, following the ingestion of Fersolate tablets, have been described. The history and clinical findings in the two cases showed marked similarity. Both were successfully treated surgically. It is believed that these are the first two cases to be recorded.

We would like to express our thanks to Dr. R. W. Brookfield for referring *Case* 2.

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SYMPATHECTOMY IN THE TREATMENT OF BENIGN AND MALIGNANT HYPERTENSION*

A REVIEW OF 76 PATIENTS

By C. J. LONGLAND and W. E. GIBB

1. INTRODUCTION

We have had the opportunity of reviewing the cases of arterial hypertension operated on in the Surgical Professorial Unit, St. Bartholomew's Hospital, since 1937, and in the following account we have considered some aspects of their response to sympathectomy. On the one hand, all these patients had in common a sustained rise in diastolic pressure; on the other, they displayed a diversity of symptoms, signs, and aetiology.

It is accepted that permanent diastolic hypertension is the result of generally increased peripheral resistance in the systemic circulation. The morbid processes causing the increased resistance are usually obscure, and consequently the prognostic significance of the physical sign of a raised arterial pressure is hard to judge. Yet, however imprecise the relationship between blood-pressure level and other aspects of hypertensive disease may be, it is commonly thought desirable to reduce high pressures; thereby strain on the cardiovascular system may be lessened and secondary effects of the raised pressure diminished. Since sympathectomy is directed towards reducing peripheral resistance, we have felt that its first aim should be to bring about a reduction of pressure, and by its ability to achieve this it should in the first place be judged. We have, therefore, paid careful attention to the changes in diastolic pressure following operation. It is recognized that patients may obtain benefit from operation even without clear-cut changes in blood-pressure level; a most important benefit is prolongation of life, and we have endeavoured to assess the effect of sympathectomy on survival in the malignant type of disease. Both reduction of blood-pressure and survival time can be objectively studied and may be expected to throw light on the influence of sympathectomy on the disease process; this is less true of relief of symptoms, but we have attempted to show what symptomatic relief was obtained.

Malignant Hypertension.—Before attempting to classify the patients, it is necessary to consider malignant hypertension. It appears to be generally recognized that the term is one useful to describe the clinical picture presented by those cases of rapidly progressive fatal hypertensive disease tending to renal failure. It is accepted that the fully developed clinical picture presents the following features: persistently severe diastolic hypertension with cardiac stress, progressive renal impairment with an abnormal urine, and a retinopathy with hæmorrhages, exudates, and œdema of the optic disks.

Differences of opinion exist, however, about certain points. Some authors (Platt and Stanbury, 1950) reserve the term for those cases in which no cause other than the hypertension can be found to initiate the clinical and pathological changes; others (Derow and Altschule, 1935) use it in a wider sense to include cases caused by primary renal disease which they term "secondary malignant hypertension". Again, both Fishberg (1939) and Ellis (1942) consider that a diagnosis of malignant hypertension should not be made in the absence of papillœdema and that this sign distinguishes malignant from benign hypertension. Goldring and Chasis (1944), on the other hand, state that the onset of the malignant phase of essential hypertension is characterized by the appearance of marked albuminuria, and that papillœdema may be absent.

In 1919 Fahr first described the characteristic renal lesions of necrotizing arteriolitis accompanying a rapidly progressive hypertensive disease ending in renal failure, and this he termed 'malignant nephrosclerosis'. Since then the incidence of necrotizing arteriolitis in cases of clinical malignant hypertension has been reported as being very variable. Thus Castleman and Smithwick (1943) failed to find evidence of a specific lesion in a series of renal biopsies from patients with clinical evidence of malignant hypertension.

It seems, therefore, that though the fully developed clinical picture of malignant hypertension is fairly clear, the recognition of the early stages is difficult. This is of fundamental importance, for if sympathectomy is to modify the malignant process it must presumably be applied early. Much stress has been laid on papillœdema as an early sign, but its significance in some cases is open to question; it is certainly not specific to the disease process, for it occurs in other conditions such as cerebral tumour and occasionally in right-sided heart failure, subsiding as the cardiac state improves (Fishberg, 1948; Beaumont and Hearn, 1948). A retinopathy of exudates and hæmorrhages would seem to be more definite evidence of disease of the retinal vessels, and frequently of a general vascular necrosis, and we have been impressed with the value of these as signs of severe hypertensive disease.

Uncertainties about the recognition of the earliest manifestations of the malignant process disturb the assessment of its treatment, since the unintentional inclusion of patients not having true malignant hypertension will of necessity improve survival rates. We must at once disclaim infallibility in our own selection of malignant cases.

The Method of Classification.—From the point of view of prognosis the best method of classification available at present is that based on examination of the optic fundus. Its value was clearly shown by Keith, Wagener, and Barker (1939), whose well-known four groups have formed the basis of

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subsequent classifications. In their paper, in addition to fundus changes, they described certain rather ill-defined clinical characteristics for each group; it is difficult to know how much weight they attached to these latter in grouping their patients, but there is no doubt that their classification was primarily a funduscopic one. Their 219 patients were followed for 5–9 years and provide a standard against which survivals in other series may be compared. Woods and Peet (1941) proposed that the fundus changes alone should be used, since they are objective signs, and they modified the four eye grades slightly. We have likewise utilized the fundus changes only and have slightly modified the original eye grades to render classification easier. They are set out for comparison below :—

Fundus	Keith, Wagener, and Barker	Authors' Series
Grade I	Mild narrowing or sclerosis of arteries.	Normal fundi; mild narrowing or sclerosis of arteries.
Grade II	More marked sclerosis; exaggerated light reflex; irregular narrowing and arteriovenous compression.	Marked sclerosis, usually with arteriovenous compression, with or without a few hæmorrhages.
Grade III	Retinitis (œdema, cotton-wool patches, hæmorrhages) with sclerotic and spastic arterial lesions	Retinitis (characteristically cotton-wool patch exudates) with or without arterial changes
Grade IV	Grade III, with measurable papilloedema.	Grade III, with papill-œdema.

Though clear arterial changes have not invariably been noted in our Grade III patients and the papillœdema in our Grade IV was usually not measured, it is difficult to believe that our selection of patients for these grades differs from that of Keith, Wagener, and Barker, for patients with retinitis could hardly have been put in any grades but III and IV.

Descriptions of the pre-operative fundus appearances were made in all patients, nearly always by ophthalmologists and the majority by one ophthalmologist who took a special interest in them. Guided by their reports we have placed the patients in the appropriate fundus grades. One or two hæmorrhages in a fundus otherwise showing only arteriosclerotic changes have not been thought sufficient to warrant placing the case in Fundus Grade III; the presence of exudate has been the essential criterion of this grade.

Though grading was on the whole straightforward, some patients could not be fitted into any of the four grades. They showed mild œdema of the disk or retina and no other change except a variable degree of arteriosclerosis of the retinal vessels.

A very striking difference is apparent between Fundus Grades I and II and Fundus Grades III and IV in the numbers still alive at the time of the follow-up investigation. Most patients in the first two fundus grades were still alive, whereas most in the last two fundus grades had died (*Table I*). Bearing in mind the points mentioned above in discussing malignant hypertension, and believing that the value clinically of the term 'malignant hypertension' is that it conveys a bad prognosis for life, we have considered all patients in Fundus Grades III and IV to have malignant hypertension, and those in Fundus Grades I and II to have benign hypertension. The small group of patients with œdema of the retina or disk who did not fit into any of the four fundus grades have been found to live longer than most of those in the malignant group after operation; since several are still alive their survival times are not yet known and they have been put into an 'Intermediate Group'.

Table I.—PATIENTS ALIVE AT THE TIME OF FOLLOW-UP

	Total No. of Patients	*Alive at End of F.U.*	*Average Survival of those Dying*	*Longest Survival*
Fundus Grades I and II (Benign)	40	31*	3 yr.	13 yr. (alive)
Fundus Grades III and IV (Malignant)	30	4	2 yr.	7 yr. (dead)

* This figure excludes 2 patients lost sight of and 2 who committed suicide; 5 of the 40 in this group are known to have died of their disease.

Note: Patients are fairly equally distributed between the two groups as regards date of operation, except for a small relative excess of benign over malignant cases in the last years. This constitutes a slight bias in favour of the benign group.

The total number of patients is 76; the numbers in the various categories are shown in *Table II*.

Table II.—CLASSIFICATION BY FUNDUS GRADE

	Number of Patients		*Clinical Group*
Grade I	8	40	Benign
Grade II	32		
Intermediate group	6	6	Intermediate
Grade III	11	30	Malignant
Grade IV	19		
Total	76		

2. THE PATIENTS AND OPERATIONS EMPLOYED

The patients were referred for operation by various physicians and few were refused; it was natural that they tended to be the severe cases which were not being controlled by medical means. It early became evident that those in the terminal stages of renal insufficiency were not benefited by operation, and thereafter such cases were not accepted. In general, patients were accepted on compassionate grounds for one or more of the following reasons :—

Symptoms demanding relief :—
- Intractable headache;
- Visual defect;
- Encephalopathy;
- Dyspnœa;
- Fatigue and exhaustion.

Evidence of progressive disease :—
- Malignant hypertension;
- High pressure in young people;
- Nephritis.

Clinical State.—The majority of patients were in quite good general health but showed a tendency to apprehension and nervousness. The cardiac reserve, as judged by the response to moderate activity, such as walking on the flat, was generally good, though hurrying induced breathlessness. Most had been carrying on with their work, though often

with difficulty, and had become easily fatigued. Headaches were usually a prominent and troublesome complaint.

Deviations from this pattern, though occurring in the benign group, which included patients with dyspnœa at rest, angina of effort, fits, and poor health and exhaustion, were frequent in the malignant group. Work had been more often given up, either because of the severity of the symptoms or on a doctor's advice, visual disturbances were common,

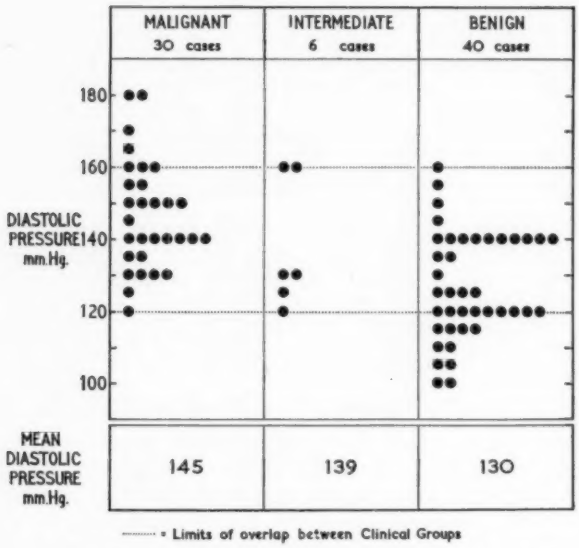

FIG. 464.—The pre-operative diastolic pressures of all patients in each of the three clinical groups are shown; 15 in the malignant group and 26 in the benign group had pressures between 120 and 140 mm. Hg.

and abdominal symptoms such as pain and vomiting were noted. Cerebral disturbances, including loss of consciousness, paresis, and marked depressive states, were not infrequent.

The youngest patient was 17 and the oldest 55 years. The numbers of patients under and over 40 years were about the same; the malignant cases occurred more frequently in the group below 40 years, the benign cases more fequently in the group over 40 years. There was a small preponderance of women, made up entirely of an excess of benign cases.

Duration of Symptoms before Operation.—In the absence of some sudden event, such as interference with vision, it was often difficult to determine the length of history. Symptoms such as headache, bilious attacks, and tiredness are so common apart from established hypertension that it is difficult to know what relation they bear to the disease process. In a number of instances the blood-pressure was known to be raised before symptoms appeared.

Extremes of one month (visual defect) and twenty years (headache) were encountered. The duration of symptoms in each clinical group as far as could be judged was as follows:—

	Mean	*Range*
Benign group	5 years	1–20 years
Intermediate group	4 years	1½–7 years
Malignant group	2 years	½–7 years

Blood-pressure.—The pre-operative diastolic blood-pressures of the patients in this series ranged from 100 to 180 mm. Hg, measured in hospital. Only diastolic blood-pressure is considered in this paper.

The malignant cases tended to have somewhat higher pressures than the benign, but there is a great overlap between the two groups, so much so that half of the malignant cases and two-thirds of the benign cases had pressures between 120 and 140 mm. Hg before operation. The mean pre-operative diastolic pressures in the three clinical groups are analysed in *Fig.* 464. It is evident that the height of the blood-pressure alone does not determine the clinical grouping of the patient, though the highest pressures occurred in the malignant group.

Renal Changes.—A blood-urea value of over 40 mg. per cent is taken to indicate severe renal damage. Depression of the urea-clearance value below 60 per cent of normal with a blood-urea of less than 40 mg. per cent is taken to indicate a lesser degree of damage. The presence of albumin in the urine without the foregoing evidence of impaired renal function is taken to indicate still milder renal damage. For convenience, these degrees have been designated Renal Grades IV, III, II respectively. Renal Grade I consists of those with normal urine and no depression of renal function. In many instances the blood-urea and urea-clearance had only been estimated once, and when they were close to the border lines the reliability of the grading is open to question, for, as is well known, repeated readings may vary. A similar difficulty applies to the finding of albuminuria; repeated tests were nearly always done, sometimes with small amounts present, sometimes with none; the presence of albumin on some occasions, if not all, was considered important. Some cases could not be put in Renal Grade I because of the presence of red cells or casts in the urinary deposit, though no other abnormality was recorded; they were put into Renal Grade II. Although Renal Grades III and IV are based on impairment of renal function, whereas Renal Grade II indicates the presence of abnormal urinary constituents, nearly all cases in the former groups had albuminuria; in a very few cases no urinary abnormality was found at the time the patient was investigated, but the urea-clearance was below 60 per cent of normal and they are therefore included in Renal Grade III.

In *Table III* the patients in each fundus grade are analysed according to their renal grades. In 5 patients there was insufficient information available to determine their renal grades and they have been omitted. The table shows a considerable degree of correlation between fundus and renal grades. It will be noted that the patients put into the intermediate group had few renal changes.

It is noteworthy that in these patients referred for operation, impairment of renal function demonstrable by the tests employed (Renal Grades III and IV) was somewhat infrequent in the benign group (13·5 per cent), whereas it was common in the malignant group (62 per cent), and the changes were often advanced (Renal Grade IV). Altogether 96 per cent of the malignant group and 57 per cent of the benign group had renal abnormalities (Renal Grades II,

III, and IV). Of 332 consecutive hypertensives entering the hospital, 7 per cent had abnormal urines, so that by comparison with this sample of the general

Table III.—TABLE OF RENAL FINDINGS

	Fundus Grades	Renal Grades I	II	III	IV	Total	Impaired Renal Function
Benign	I	3	4	1	0	8	5/37
	II	13	12	3	1†	29	
Intermediate		3	2	0	0	5	0/5
Malignant	III	1*	4	2	3	10	18/29
	IV	0	6	5	8	19	
Total		20	28	11	12	71	

* Renal Grade I, but died of uræmia 18 months after unilateral operation.

† Behaved like a malignant case.

run of hypertensives the patients referred for operation had a very high incidence of renal lesions.

The presence of albumin always raises the question of an antecedent renal lesion, and it is very often difficult and sometimes impossible to decide whether the renal lesion is primary or secondary. We have attempted to separate the primary renal cases from those of essential hypertension, and these 16 cases are set out in *Table IV*. In no instance was there a known attack of acute glomerulo-tubular nephritis. In addition to the history and urinary findings, youth and the absence of a family history of hypertension inclined us towards the diagnosis of nephritis. Pyelonephritis was thought to have occurred in two cases with recurrent symptoms of pyelitis. Patients who had had toxæmia of pregnancy are included in *Table IV* whether their hypertensive disease seemed to be directly related to the toxæmia of pregnancy or not.

Table IV.—PRIMARY RENAL CASES
(Distribution according to fundus and renal grades)

	Fundus Grades	Renal Grades I	II	III	IV
Benign	I	T	T	N	
	II	T	N	T	
		P-N	T		
Malignant	III				N
					N
	IV		T	N	N
					N
					P-N

T, Toxæmia of pregnancy; N, Nephritis; P-N, Pyelonephritis.

Intravenous pyelography was carried out in most cases; excretion of the contrast medium was often impaired, even though the blood-urea was not raised. Unilateral renal abnormalities were demonstrated twice, a hydronephrosis in one patient and a non-functioning kidney due to stone in the other. Each had a nephrectomy without obvious benefit to the hypertensive disease.

Sections of kidneys obtained either by biopsy at operation or after death from 18 patients were stained for examination with hæmatoxylin and eosin. In only a few of these cases was there a correlation between the degree of histological change and the severity of the clinical illness.

Operations employed.—The great majority of the operations were done by one surgeon and great care was taken to ensure a thorough clearance of all visible sympathetic nervous tissue in the region denervated. A careful note was made of the extent of the removal of the sympathetic trunk and splanchnic nerves, and in some cases these estimates were checked in terms of vertebral levels on X-ray photographs by metal markers. No post-operative assessments of the functional extent of the sympathectomies by such means as skin resistance measurements were made.

Several operations were employed :—

Type I: The Adson procedure, with bilateral infradiaphragmatic section of the splanchnic nerves

Table V.—OPERATIONS PERFORMED (76 *Cases*)

BILATERAL OPERATIONS SURVIVED :—

Procedure	Clinical Group: Benign	Intermediate	Malignant	Total
Type I	16	4	9	29
Type II	8	—	2	10
Type III	9	—	7	16
Miscellaneous	4	1	2	7
	37	5	20	62

UNILATERAL OPERATIONS SURVIVED :—

Judged too ill for second side	4	
Did not return for second side	4	9
Nephrectomy one side, sympathectomy second side	1	
OPERATIVE DEATHS		5
TOTAL		76

and of the lumbar sympathetic trunk from approximately T.12 to L.3 vertebræ.

Type II: Bilateral transpleural resection of the splanchnic nerves and of the thoracic sympathetic trunk from approximately T.6 to T.12 vertebræ.

Type III: Thoracolumbar sympathectomy with bilateral supra- and infradiaphragmatic section of the splanchnic nerves and of the sympathetic trunk from approximately T.9 to L.3 vertebræ.

Miscellaneous Procedures.—These included: Peet's operation, bilateral upper thoracic sympathectomy in addition to Type III operation, section of the splanchnic nerves and denervation of the renal pedicle or removal of one suprarenal gland. These patients have been treated as one group.

All of these operations have in common division of the greater, lesser, and least splanchnic nerves near their terminations. They differ in the amount of these nerves removed and in the site and extent of the sympathetic trunk removed together with its visceral and parietal branches. The numbers of patients undergoing each type of operation are shown in *Table V*.

Operative Mortality.—There were 5 operative deaths in 76 patients. All deaths occurred in the malignant group, that is, 5 deaths in 30 patients, a mortality of 16·7 per cent. The causes of death in the 5 patients were: 1 uræmia six days after operation; 1 unexplained collapse twenty-four hours after operation; 1 anoxia during induction of anæsthesia; 1 dissecting aneurysm; 1 gas infection of wound.

Operative Morbidity.—The most troublesome aftermath of operation was wound pain; this was often marked though very variable, not only from patient to patient, but on the two sides of one individual. In a few it persisted for a period of years, sometimes amounting to a real handicap.

Postural hypotension and breathlessness due to redistribution of blood and impairment of the anti-gravity mechanism began to wear off in a few weeks. Cold hands due to increased vascular tone in the still innervated arm vessels persisted indefinitely and was sometimes troublesome in cold weather. This was regarded as a temperature-regulating phenomenon.

Since the legs and lower trunk were dry, excessive sweating occasionally was troublesome in the upper part of the body, but this was a very minor disability. In a few men when inquiry was made it was found that ejaculation had failed.

3. RESULTS OF OPERATION

The Assessment of Fall of Blood-pressure.—Different authors have adopted somewhat different criteria for a satisfactory fall in blood-pressure. In choosing criteria for this series, it was necessary to have regard to the conditions imposed by the late World War, which covered much of the period under review and prevented any but very infrequent post-operative examinations after discharge from hospital. Since, therefore, frequent blood-pressure readings from which to judge the prevailing post-operative pressure were not available, a fall of blood-pressure indicative of a significant change in the blood-pressure level was required which could be applied to isolated out-patient readings. Three sets of observations were made in order to determine the extent of such a fall.

1. To determine the variability of the diastolic pressure under out-patient conditions after sympathectomy, the records were studied of 13 of the patients in the present series who had attended frequently for post-operative examination.

2. Since so few of the operated cases were available, out-patient readings of 20 medically managed hypertensive patients were examined. These patients were selected from a larger group because their pressures, though fluctuating, showed no evidence of a progressive rise or fall over the period of observation, which varied from four to fifteen months.

There was little difference in the fluctuation exhibited by these two groups, a point of some interest. Of these 33 patients, 30 showed maximum differences in diastolic pressure of less than 30 mm. Hg. Thus, with the mean pressure remaining constant, fluctuations of more than ± 15 mm. Hg about the mean were uncommon.

3. In order to determine the pre-operative mean pressure for each patient operated upon, the ward charts were examined. Pressures were recorded daily, usually for about a week before operation. The pre-operative mean pressure was taken as the mean of these readings judged by eye.

Amongst patients with very high pressure these charts also showed fluctuations greater than were encountered in the out-patient series. Upon further examination it was found that no patient with a mean pressure of 135 mm. Hg or less exceeded a variation of ± 20 mm. Hg, but a number of those with a mean above 135 mm. Hg had fluctuations of up to ± 30 mm. Hg. Nearly all the out-patients had mean pressures under 135 mm. Hg; their variability was a little less than that of patients before operation.

From these observations it was concluded that for patients with pre-operative mean pressures of over 135 mm. Hg there was a high probability that the mean diastolic pressure had been reduced if subsequent occasional out-patient readings showed a fall of 30 mm. Hg or more below the pre-operative mean; the corresponding fall for patients whose pre-operative mean was 135 mm. Hg or below was 20 mm. Hg. These are referred to as ' significant blood-pressure falls '. They agree very well with the criteria of Peet and Iseberg (1946) and Evelyn, Alexander, and Cooper (1949). They also satisfy the criterion of Platt and Stanbury (1950) in nearly all cases.

Although the intention had been to look for a diastolic fall significant only of a change in blood-pressure regardless of its therapeutic worth, the falls considered significant are of an extent likely to be of therapeutic value. In many patients recorded as having significant falls, the therapeutic value will be still greater than this term indicates since their falls will have exceeded the minima required.

The Effect of Operation on Blood-pressure.—Almost without exception a fall of blood-pressure was recorded on the day following removal of part of the second sympathetic trunk and splanchnic nerves at the second operation. Then followed a gradual re-ascent of blood-pressure towards the pre-operative level; by the time the patient left hospital, usually some three weeks later, this rise had apparently ceased. The difference between the pre-operative mean and this new mean level present on discharge is here referred to as the ' immediate post-operative fall '. Subsequently, further rises of pressure might occur. A pressure remaining below the pre-operative mean for one year or longer is here referred to as a ' persisting fall '. Since sympathectomy almost invariably produced a fall in blood-pressure initially, the question becomes how great was the fall and how long did it last?

The Extent of the Immediate Post-operative Fall.—In *Table VI* are shown the immediate falls obtained in the 62 patients surviving bilateral operation. Forty-four patients (71 per cent) had a reduction of mean pressure of 20 mm. Hg or more; in 20 (32 per cent) the fall exceeded 40 mm. Hg.

The following factors have been investigated for their effect on the immediate fall: (1) The pre-operative blood-pressure; (2) The clinical group; (3) The type of operation; (4) The age and sex of the patient.

The Pre-operative Blood-pressure.—Table VI also shows the difference in response between patients with very high pressures and those with less elevated pressures, 135 mm. Hg being used as the dividing

line. Patients with very high pressures secured large falls frequently. *Fig.* 465 shows the correlation between pre-operative pressure and immediate post-operative fall.

It is of interest to note that a number of patients failed to show any (less than 10 mm. Hg) immediate blood-pressure fall, regardless of the height of their pre-operative pressure. No common factor to account for their failure to respond could be found.

Table VI.—Immediate Blood-pressure Fall

Pre-operative B.P.	Number of Patients	No Response < 10 mm. Hg Fall	Immediate B.P. Fall in mm. Hg			
			10–19	20–29	30–39	40 and over
Over 135 mm. Hg	29	4	0	0	8	17
Under 135 mm. Hg	33	8	6	12	4	3
Total	62	12	6	12	12	20

It would seem that either the nature of their hypertension was such that it could not be influenced by sympathetic nerve section, or else that because of anatomical variations sympathectomy was inadequate.

Clinical Group.—Since there were few patients in the Intermediate Group, they were added to the Benign Group, so that two clinical groups, Malignant and Benign, were considered. The proportions of significant immediate falls occurring in each group were compared : the malignant group (17/20 = 85 per cent) showed a higher incidence of significant falls than the benign (27/42 = 64 per cent). This difference could not be attributed only to the higher pressures prevailing in the former group, for, as *Table VII* shows, the two clinical groups behaved differently in the lower blood-pressure ranges. The proportion of significant immediate falls was high and uniform in the malignant group ; it was high among patients in the benign group with very high pressures, but much lower in those with lower pressures.

Table VII.

	Malignant		Benign	
	Significant Fall	Total Cases	Significant Fall	Total Cases
Higher B.P. (Over 135 mm. Hg)	12	14	13	15
Lower B.P. (Under 135 mm. Hg)	5	6	14	27
Total	17	20	27	42

The Type of Operation.—The proportions of significant falls achieved by the various operations were examined. It has been shown that both pre-operative blood-pressure and clinical group have an influence on the immediate fall. Three composite groups emerge, viz., Malignant, Benign Higher B.P., and Benign Lower B.P. When the four types of operation were split among these three groups, very small sub-groups were formed and no clear difference in favour of any type of operation could be seen. However, the average blood-pressure fall produced by the Type III operation (thoracolumbar sympathectomy) was found to be slightly greater than that achieved by the other types ; the Type III operation

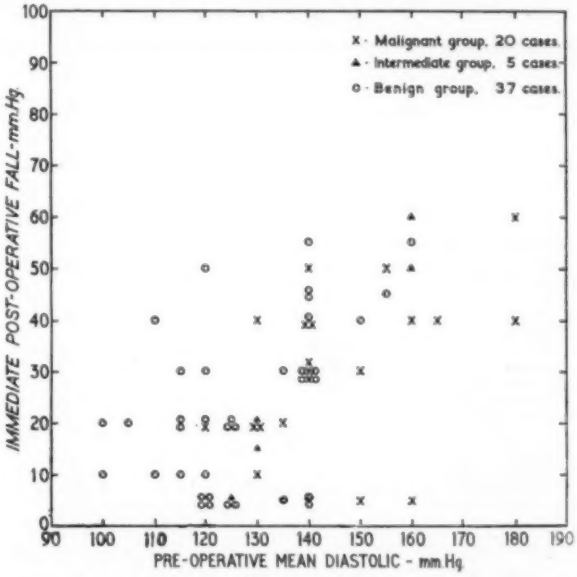

Fig. 465.—The immediate post-operative diastolic falls are plotted against the pre-operative diastolic pressures for all patients surviving bilateral operations. Greater falls occurred in patients with higher pre-operative pressures irrespective of the clinical groups, which are distinguished.

group was not especially favoured with high pre-operative pressures or the malignant type of disease. This suggests a possible superiority of the thoracolumbar operation.

Sex and Age.—These have been examined for their effect on the proportion of significant falls. This analysis showed : (1) a tendency for significant falls to occur a little more frequently among women than men, (2) a noteworthy absence of significant falls in patients over 45 years of age in the Benign Lower B.P. Group. In other patients of this age, significant post-operative falls were the rule.

The Duration of Blood-pressure Fall.—Patients were followed for a minimum of three years. Of the 62 who survived bilateral operation, 3 of the malignant cases died in less than three years and information is inadequate for 9, leaving 50 for analysis (*Table VIII*). In general, patients not having an immediate significant fall did not show a significant fall later. There were two exceptions, and for convenience they have been added to those with immediate significant falls. Many patients with immediate significant falls later relapsed—that is, their pressures rose to levels not significantly below their pre-operative mean pressure (though frequently still somewhat below). In *Table VIII* are traced the immediate responses and subsequent relapses during the first post-operative year, and during the second and third post-operative years considered together, in each of the three composite groups. The Malignant Group fared worst, relapses being frequent in both post-operative periods despite

a high proportion of good initial responses. Only 2 of 15 patients continued to have significantly lower pressures three years after operation. In the Benign Higher B.P. Group the good initial response was much reduced by relapses in the first year, by the end of which it differed little from the Lower B.P.

Table VIII.—Duration of Blood-pressure Fall

	Malignant		Benign				Total	
			Higher B.P.		*Lower B.P.*			
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Patients in each group (followed 3 years +)	15	100	12	100	23	100	50	100
No response to operation	3		2		8		13	26
Significant immediate falls	12	80	10	83	15	65	37	74
Relapses in 1st post-op. year	7		5		6		18	36
Significant falls persisting 1 year	5	33	5	45	9	39	19	38
Relapses in 2nd and 3rd post-op. years	3		1		1		5	10
Significant falls persisting 3 years	2	13	4	33	8	35	14	28

Benign Group. During the second post-operative period (the second and third post-operative years) further relapses in the benign group were few; about one-third of all patients operated on in this group maintained significantly lowered pressures three years after operation. Seven of these patients were followed from four to eleven years after operation; only one further relapse was noted. In the benign group, therefore, relapses occurred for the most part in the first post-operative year.

Type of operation, sex, and age were investigated for their influence on persisting significant fall one year after operation in the same way as for immediate significant fall. The Type III operation (thoracolumbar sympathectomy) again showed an advantage over the others, for it secured the greatest proportion of persisting falls. This was particularly striking in the Benign Lower B.P. Group. Sex had no discernible influence, but there was an increased tendency to relapse among patients over 45 years of age.

The Sodium Amytal Test.—This test was carried out on 25 patients in the hope that it might prove of some value in forecasting whether or not worthwhile blood-pressure falls would be achieved by sympathectomy. Three grains of sodium amytal were administered hourly up to three doses until the patient fell asleep and the blood-pressure was recorded over this period. *Table IX* shows that falls of diastolic pressure between 0 and 55 mm. Hg were obtained, but that these falls bore no relationship to the falls persisting at one year after operation. The test has been of no value.

The Effect of Operation on Survival.—Since few of the patients in the benign and intermediate groups have yet died, the effect of operation on survival will be considered only for the 25 patients undergoing bilateral operation in the malignant group, most of whom are already dead. It is obviously desirable to compare the results of operation with those of medical treatment carried out under similar conditions; however, in a review of the cases of malignant hypertension admitted to the wards of this hospital in the last five years it was found that most had been operated on, the remainder being for the most part unfit for operation and dying soon after admission. We have, therefore, had to look elsewhere for a standard of comparison and have used the medically treated series of Keith, Wagener, and Barker (1939), which has also been utilized by Woods and Peet (1941), Peet and Iseberg (1946), and Smithwick (1951).

Table IX.—Prognostic Value of Sodium Amytal Test

Over 25 mm. falls
11 cases. 3 had significant falls lasting 1 year +

Under 25 mm. falls
14 cases. 8 had significant falls lasting 1 year +

3 *cases had falls of 55 mm. Hg*
1 had no significant post-operative fall
1 had a temporary significant post-operative fall
1 had a significant post-operative fall lasting over 2 years

Our malignant group contains patients in Fundus Grades III and IV; since Keith, Wagener, and Barker have shown a clear difference of survival in these two grades they cannot be considered together. There are, therefore, 9 cases to be compared with 37 of the medical series in Fundus Grade III and 16 cases to be compared with 147 in Fundus Grade IV; these comparisons are made in *Fig.* 466 (Fundus Grade III) and *Fig.* 467 (Fundus Grade IV). Since the survivals of the medical series were presented as curves showing the percentage of survivors plotted against time of survival, we have charted our cases in the same way despite the small numbers. In Fundus Grade III 11·1 per cent, and in Fundus Grade IV 6·25 per cent is the equivalent of one patient in our series. Two patients in each grade still living have not been followed for the whole period covered by each curve. To allow for the uncertainty thus introduced by their future behaviour the curves have been split; the upper curve in each grade continues on the assumption that each of these living patients continues to survive and the lower on the assumption that each dies within six months after they were last seen. Hence the split parts of the curves embrace the best and worst possibilities.

In both grades there is apparent a better survival rate in the surgical than the medical series in the middle parts of the curves. Operation deaths cause an abrupt initial fall in survival of the surgical cases. The operation survivors then apparently do better than the medical cases until about the sixth year in Grade III and the fourth year in Grade IV, when the curves again converge. The differences between the curves in each grade have been examined statistically. In Grade III the difference in percentage survival rates, taking into account the numbers in the series compared, is significant at three years at the 5 per cent level of probability. The

differences at 1 year and 2 years in Grade IV are just not significant, while at 3 years the difference is certainly not significant. The surgical curve in Grade III therefore suggests a real improvement in survival, and if with the addition of more cases its form remains the same, a statistically significant improvement would become established in Grade IV also.

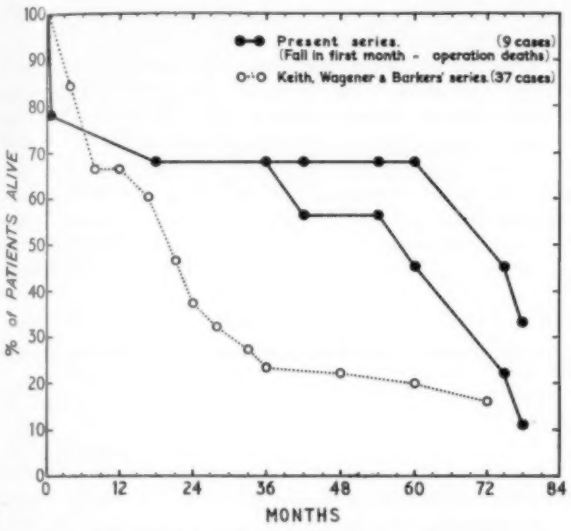
Present series. (9 cases)
(Fall in first month - operation deaths)
Keith, Wagener & Barkers' series. (37 cases)
% of PATIENTS ALIVE
MONTHS

FIG. 466.—The survival times after sympathectomy are compared with the survival times of Keith, Wagener, and Barker's series for Fundus Grade III.

Peet's experience has already provided evidence based on larger numbers which has been published in the form of survival curves compared with those of Keith, Wagener and Barker's series: 33 Fundus Grade III cases were reported in 1941 (Woods and Peet) and 143 Fundus Grade IV cases in 1946 (Peet and Iseberg). Both these survival curves resemble those of the present series closely.

The question arises whether the difference between the surgical and medical survivals is due to the selection of cases or operative treatment. Since, as was mentioned above, some few patients with the worst manifestations of the disease were not offered operation, selection must play some part, for in the medical series presumably none was excluded. So far as our evidence goes we conclude that operation offered some prospect of prolongation of life by a year or two; the operative mortality was, however, considerable.

It might be expected that the progress of malignant hypertensive disease would be slowed by securing a persisting fall in the blood-pressure. Comparison of the survival periods of patients with and without significant falls persisting for a year or more revealed no clear difference. Since a few of the former group are still alive, an advantage may later become apparent on the side of those with a sustained fall in pressure.

Renal Changes and Survival.—In describing the pre-operative state of the patients, a system of grading of renal lesions was employed which was found to have a degree of correspondence with the fundus grading (*Table III*), and might, therefore, have some prognostic value.

As previously shown (*Table I*), at the time of the follow-up investigation most of the patients in the benign group were living, whereas most in the malignant group had died. All patients surviving bilateral operation for whom renal findings are complete (52 cases) have been tabulated by renal grades and

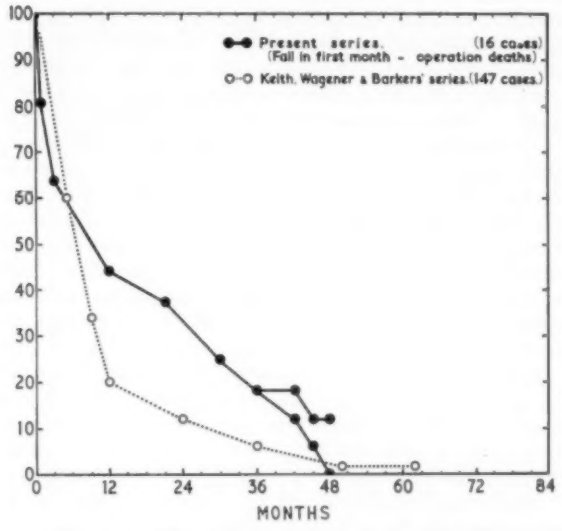

FIG. 467.—The survival times after sympathectomy are compared with the survival times of Keith, Wagener, and Barker's series for Fundus Grade IV.

Tables X, XI.—SURVIVAL AND RENAL GRADE

Table X.

CLINICAL GROUPS	RENAL GRADES			
	I	II	III	IV
Benign (Fundus Grades I and II):—				
Alive	14	13	2	0
Dead	1	1	2	1
Malignant (Fundus Grades III and IV):—				
Alive	0	3	0	1
Dead	0	3	7	4
Totals	15	20	11	6

(Operation deaths omitted.)

Table XI.

	TOTAL NUMBER	POST-OPERATIVE YEARS SURVIVED							
		1	2	3	4	5	6	7	8
Fundus Grade IV All cases	12	10	6	2 (1)	(1)	0			
Kidney Grade IV	3	3	1	0					
" " III	5	3	2	1	0				
" " II	4	4	3	1 (1)	(1)	0			
Fundus Grade III All cases	6	6	5	3 (2)	3	3	1	1	0
Kidney Grade IV	2	2	1	(1)					
" " III	2	2	2	2	2	2	0		
" " II	2	2	2	1 (1)	1	1	1	1	0

( ) indicates patients still alive in that year.

clinical groups to show survivors and non-survivors (*Table X*). There were few survivors in Renal Grades III and IV (depression of renal function) and few deaths in Renal Grades I and II; the table shows fundus grading and renal grading to have been of about equal prognostic value. A combination of funduscopic and renal grading in the malignant group appears to provide a fairly good prognostic guide. This is shown in *Table XI* (18 cases).

Altogether 12 patients had elevated blood-urea levels (none exceeded 70 mg. per cent), and therefore fell into Renal Grade IV. The outlook for them was bad. Six either died as a result of operation, or were judged too ill for the second operation to be undertaken and died within a few months. The longest survival was 2½ years, following bilateral operation. Northfield (1948) has pointed out the uselessness of operation when the blood-urea level is much raised. The outlook in Renal Grade III was less bad. There were 11 patients, all of whom survived bilateral operation, and the longest survival period was 5½ years after operation; another is alive 5 years after operation.

Page and Corcoran (1944) believed that for the same degree of renal dysfunction patients with chronic nephritis survived longer than those with primary malignant hypertension, though the difference was not great. The same tendency is apparent in this series, which contains eight patients regarded as having chronic nephritis. Six patients had had toxæmia of pregnancy and they have done well. All are alive from 3 to 10 years after operation, including one placed in Fundus Grade IV and one in Renal Grade III. Four of these six patients had sustained falls of blood-pressure for 3 years or more without relapse.

The Intermediate Group.—This comprises six patients whose funduscopic signs of retinal or papillary œdema without exudates or hæmorrhages did not allow them to be fitted into any of the four fundus grades. Diastolic pressures ranged from 125 to 160 mm. Hg, and all were placed in Renal Grades I and II. Four were under 35 years of age. The prognosis in this group after operation is promising by comparison with the malignant group, to which their funduscopic appearances bore a resemblance. Four are alive 3 to 8 years after operation; the deaths occurred 6 years (cardiorenal failure) and 1 year after operation (cerebrovascular accident). Too grave a prognostic import should not be attached to retinal or papillary œdema occurring alone.

Effect of Operation on Symptoms.—We have so far considered observable sequels of operation which have a certain objective value. Symptomatic response, though of the greatest practical importance, is of much less value in endeavouring to determine the efficacy of a particular treatment in modifying the disease process for at least two reasons. The patients as a group tend to be somewhat apprehensive, suggestible, and dependent on their medical adviser. His outlook may colour their responses considerably, which also vary a great deal with their own moods and feelings. Further, many of their symptoms are of a general kind related to varying degrees of ill health with a disturbing inability to do as much as they formerly did and therefore are difficult to describe and assess accurately. Any treatment, provided it is active treatment, may work minor wonders.

There are, however, more easily definable symptoms and these include headache, shortness of breath, and visual disturbances.

Sympathectomy may have results other than a direct diminution of systemic peripheral resistance which tend to relieve symptoms. After undergoing a fairly long period in hospital of about six weeks with two operations, followed usually by considerable postural hypotension and the necessity for a convalescent period of readjustment, a patient may become stabilized at a slower and less energetic rate of living; several have remarked that the operations have made them 'go slow'. The loss of some considerable part of their nervous vasomotor control may be a factor, for mobilization of blood for sudden effort is presumably less effectual; this leads to the suspicion that some mild post-operative breathlessness on exertion in the years after operation may be a result of the operation and not evidence of hypertensive disease. Such a tendency to avoid effort and take things more slowly is likely to improve symptoms.

Table XII.—Effect of Operation on Symptoms

	Malignant	Benign and Intermediate	Total	Significant B.P. Fall 1 Year +	No Information about Late B.P. Fall
Symptomatically improved	14	23	37	19	4
Symptomatically unimproved	0	9	9	1	1

Percentage of cases improved: 80 per cent.

The patients' leading symptoms are considered in those surviving bilateral operation for one or more years.

Symptoms have been investigated in 46 patients who survived bilateral operation for a year or more. The numbers of patients improved and unimproved are set out in *Table XII*, together with the numbers having significant persisting diastolic falls.

The patients were seen by various observers at varying intervals of not less than one year after operation, and are entered as improved or unimproved according to whether their main symptom had been consistently better or no better since operation.

It will be seen that all the malignant cases declared themselves improved whereas more than a quarter of the benign cases were unimproved. Although symptomatic relief did not depend on achieving what was thought to be a worthwhile fall in blood-pressure, at least 13 patients out of 37 being symptomatically improved without a persisting blood-pressure fall, failure to improve symptoms was associated with failure to lower blood-pressure significantly in 7 of 8 patients.

Thus it appears that symptomatic improvement (80 per cent of all the cases) was much more frequent than persisting improvement in blood-pressure (19/50 cases for one year or 38 per cent, *see Table VIII*), but that among those whose pressure was not reduced some were not relieved of symptoms either;

these were chiefly in the benign group. The relief of symptoms in those whose pressures remained high must be ascribed either to a redistribution of peripheral resistance or to a non-specific or indirect effect of the operative management as suggested above.

The response of individual symptoms is shown in *Table XIII*.

Table XIII.—SYMPTOMS IMPROVED

	Number of Patients with the Symptoms	*Number Improved*	*Percentage Improved*
Headache	39	35	90
Fatigue	26	19	73
Visual defect	9	6	—
Dyspnœa	11	7	—

Headache was consistently improved and the relief was generally of real value to the patient; it did not depend on blood-pressure fall and often dated from the first operation; several of those having an operation on one side only had lasting relief. Headaches began to recur in some patients after a year or more, but were not severe.

Relief of the other symptoms analysed was usually less marked, though lessened fatigue was of great benefit to some. In most instances the relief of dyspnœa seemed to depend on a fall of blood-pressure.

4. SYMPATHECTOMY AND BLOOD-PRESSURE CHANGES

Evidence has been obtained in the present series which suggests that the blood-pressure after sympathectomy in hypertensive patients is to some extent governed by post-sympathectomy changes of tone in the vessels of the denervated region similar to those which have been demonstrated in the limbs, particularly by Barcroft and Walker (1949), Lynn and Barcroft (1950), and Duff (1951). The legs and the splanchnic area are the important components of the region denervated by thoracolumbar sympathectomy. The data are shown in *Fig.* 468. From the daily blood-pressure readings in six patients after thoracolumbar sympathectomy on the second side, a mean curve has been drawn to show the daily changes in blood-pressure following sympathectomy. This curve is compared with that showing the mean daily changes in blood-flow through the foot after lumbar sympathectomy in six patients with normal vessels obtained by Lynn and Barcroft (1950). The latter curve has been orientated with respect to changes in peripheral resistance in the same direction as the first; thus a fall in peripheral resistance is indicated in both by a fall in the curves. The assumption is made that in the hypertensive patients the changes in blood-pressure are the result largely, if not solely, of changes in peripheral resistance. The correspondence in direction and time relationships of the two curves is close, and this strongly suggests that the peripheral resistance in the foot in the one series, and in the lower half of the body in the other, has followed a similar pattern of change. It is unlikely that the behaviour of the leg vessels alone could have accounted for the blood-pressure changes, since denervation of the legs does not alter the blood-pressure in hypertension, whereas a purely thoracic sympathectomy can do so. The vessels of the splanchnic region seem, therefore, to have responded to sympathectomy in much the same way as the foot vessels, having regained tone to a considerable degree in the second post-operative week.

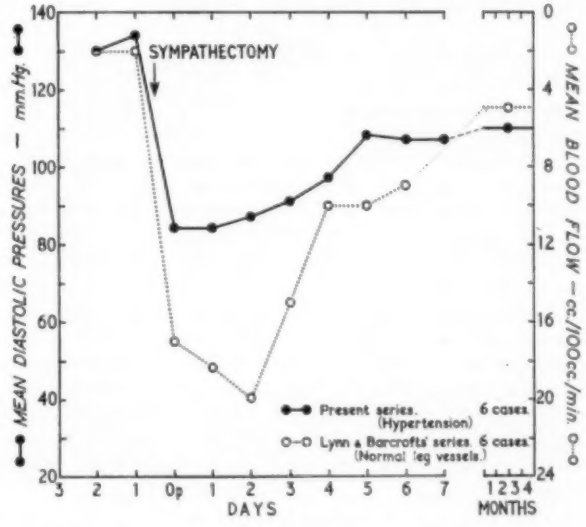

FIG. 468.—The means of the post-operative diastolic pressures, after thoracolumbar sympathectomy on the second side, in 6 hypertensive patients are compared with the means of the daily measurements of volume flow in the feet, after lumbar sympathectomy, in 6 patients with normal cardiovascular systems (Lynn and Barcroft's series).

It was after this, about the third week, that the figure for the 'immediate blood-pressure fall' was obtained.

Return of sympathetic function in the limb after sympathectomy has been repeatedly demonstrated and is often evident a year after operation (Barcroft and Hamilton, 1948; Haxton, 1947). Such return of function after sympathectomy for hypertension may well account for some of the blood-pressure relapses described above; they were particularly numerous in the first post-operative year. Other relapses may have been due to an increase of the hypertensive process, for Keith, Woolf, and Gilchrist (1949) noted a gradual rise in the diastolic pressures of medically treated patients with hypertension. This would, no doubt, apply particularly to the malignant type of disease; and relapse continued to be frequent in this group in the second and third post-operative years.

These three factors, post-sympathectomy regain of tone, re-establishment of sympathetic function, and increase in the hypertensive process, must play a large part in determining the blood-pressure level as time passes after operation.

COMMENT

The foregoing results do not put sympathectomy for arterial hypertension in a very favourable light. Considered as a means of lowering raised pressure, it failed to make any prolonged impression in the majority of patients, only 28 per cent having significantly lower pressures three years after operation. This figure accords fairly well with the findings of

Evelyn, Alexander, and Cooper (1949), who in their careful review of patients operated on at the Massachusetts General Hospital found 41 per cent of significant falls after two years and 21 per cent after five years. More disappointing was its failure to achieve any considerable improvement in survival in malignant hypertension, particularly in view of the reports of Peet and Iseberg (1946) and Smithwick (1951).

To the credit of sympathectomy must be set those patients who had a prolonged significant reduction of blood-pressure, and probably others whose pressures were reduced for variable periods but insufficiently to satisfy the criteria of significance. To this effect on blood-pressure must be added relief of symptoms, which was notable in four-fifths of the patients, an important result.

This analysis suggests that the operation is of value for relief of symptoms when less drastic measures fail, and that it may be considered as a means of reducing blood-pressure; there is no doubt that in some patients a lasting reduction of pressure is obtained, but a temporary fall is the usual result. The value of such temporary falls in individual patients needs carefully weighing against the inconveniences and occasional hazards of operation.

SUMMARY

Seventy-six cases of arterial hypertension treated by sympathectomy between 1937 and 1948 have been reviewed.

They have been classified into benign and malignant groups according to funduscopic findings; a system of renal grading has been found to have a correlated prognostic value.

A small group of patients with retinal or papillary œdema has been separated from the malignant group as an 'intermediate group' which promises a relatively good prognosis.

The effect of sympathectomy has been considered on diastolic blood-pressure, on survival in the malignant group, and on symptoms. Significant falls of blood-pressure were found in 71 per cent of patients on discharge from hospital; the percentage had fallen to 28 per cent three years after operation. Survival was probably slightly prolonged in the malignant group; symptoms were alleviated in 80 per cent. There is some evidence that thoracolumbar sympathectomy was more efficacious than lesser procedures.

Evidence is brought that the vessels of the splanchnic region behave in a similar way to those of the foot after sympathetic denervation. Possible reasons are given for the frequent re-ascent of the blood-pressure after the operative fall.

It is suggested that treatment of hypertensive disease by sympathectomy may be undertaken as a means of relieving intractable symptoms and of giving patients with very high pressures a period of relief. The duration of the lowered pressure cannot be foretold.

The patients reviewed in this paper were under the care of Professor Sir James Paterson Ross, K.C.V.O., and it was at his suggestion that the review was undertaken; we are indebted to him for a very great deal of help which it is a pleasure to acknowledge. We are also indebted to Mr. M. P. Curwen, of the Department of Statistics, St. Bartholomew's Hospital, for much assistance with the part of the paper dealing with the blood-pressure responses to operation. We would like to thank the staff of the Ophthalmological Department, and in particular Mr. Rupert Scott, who saw the majority of the patients, for their admirable records of funduscopic findings. We also wish to thank Dr. R. J. R. Cureton for histological examination of kidney sections, and Dr. H. O. Hartley, of the Department of Statistics, University College, London, for statistical help.

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ASSOCIATION OF PEPTIC ULCER WITH PHARYNGEAL DIVERTICULUM

By P. R. SLADE, Bournemouth

During the past year 3 cases have been encountered showing a peptic ulcer in association with a pharyngeal diverticulum. No previous reference to this association has been traced in the literature. These cases occurred in a general hospital where pharyngeal diverticula are not common. Sufferers from pharyngeal diverticula are necessarily somewhat ill nourished and it is tempting to suppose that the association may not be so very uncommon.

CASE REPORTS

Case 1.—A. E., female, aged 73. Housewife. Admitted as an emergency on Sept. 15, 1951.

History.—For three weeks before admission she had complained of vague general abdominal pain, not

Fig. 469.—*Case* 1. Barium swallow showing pouch.

associated with food. She had had a similar attack about one year previously which lasted for about fourteen days. For the past three or four years she had had a tendency to vomit during or immediately after a meal. She disliked and avoided milk and all 'sloppy' foods.

Three days before admission her pain became much more severe, she vomited continuously, and had absolute constipation.

On Examination.—A very thin, frail old lady. Chest was barrell-shaped, with marked kyphosis of the dorsal spine. Lungs were emphysematous. Heart was enlarged. Abdomen was somewhat distended. There was generalized tenderness and rebound tenderness.

At Operation (Sept. 15, 1951).—Right paramedian incision. There was general peritonitis due to perforation of a chronic indurated ulcer on the anterior surface of the first part of the duodenum. The perforation was closed with sutures and an omental patch.

Progress.—She made a good recovery from the operation, but after about the tenth post-operative day it was noted that she vomited almost immediately after every feed. A barium swallow on Oct. 27 showed a fair-sized pharyngeal diverticulum, centrally placed at about the level of T.1 to T.4 (*Fig.* 469).

Second Operation (Nov. 2).—Collar incision. Approach from the left side. Pouch dissected out and removed in one stage. Wound drained.

Post-operative Progress.—Uneventful. She was discharged on Nov. 18. She has been seen at intervals since and has no dyspepsia or dysphagia.

Case 2.—H. T., male, aged 69. Musician. Admitted as an emergency on Nov. 30, 1951.

History.—Sudden attack of very severe abdominal pain ten hours before admission.

He stated that he had had periodic attacks of epigastric pain, about two hours after food, for the past twenty years.

He had attended the out-patient department in November, 1947, complaining of difficulty in swallowing of about eighteen months' duration. He put the site of the obstruction about the level of the root of his neck. He complained of discomfort after meals, which he could relieve by making himself vomit. A barium meal was performed at that time and the report was :—

"Œsophagus : A pouch is present about 1½ in. in length at the level of the first and second thoracic vertebræ.

"Stomach : Contains considerable residue at 6 hours.

"Duodenum : The duodenal cap is small and flattened.

"Conclusions : 1. Œsophageal pouch. 2. Duodenal ulcer."

He was put on the waiting list but did not come in when sent for.

On Examination.—An extremely thin wasted man. In obvious pain. Shocked.

Abdomen : Board-like rigidity—silent.

At Operation (Nov. 30).—Upper right paramedian incision. There was a large and very indurated ulcer of the anterior surface of the first part of the duodenum, with a large central perforation. The perforation was repaired with an omental patch.

Post-operative Progress.—He developed paralytic ileus and died on the ninth day after operation.

Post-mortem Examination.—

"Œsophagus : There was a pouch about 1½ in. long arising at the level of the cricoid cartilage.

"Lungs : Extensive bronchopneumonia of the left lung.

"Abdomen : Generalized plastic peritonitis. A small resolving right subphrenic abscess."

Case 3.—H. de M., male, aged 69. Retired civil servant. Admitted as an emergency on Dec. 16, 1951.

History.—For 24 hours had had severe pain in the right side of abdomen and chest. He also gave a history of difficulty in swallowing since 1936. He found it easier to swallow solids than liquids, and frequently regurgitated food immediately after a meal. He had had a barium swallow at St. Thomas's Hospital which had demonstrated a pharyngeal diverticulum (*Fig.* 470). He had not had any treatment. His dysphagia was increasing and he was accustomed to fill his pouch at the beginning of a meal with porridge, which he was able to bring back afterwards with the aid of a mouthwash.

In 1940 he had noted the onset of indigestion ; pain in the epigastrium about one hour after food, relieved by food and alkalis, often waking him at night.

A barium-meal examination was performed in 1945. The report was : "Stomach normal in size and position

An ulcer crater is visualized in the middle one-third of the lesser curvature." (*Fig.* 471.)

He had had medical treatment, but during the past year had had three exacerbations of his ulcer pain. He stated that he had lost 2 st. in weight since 1936.

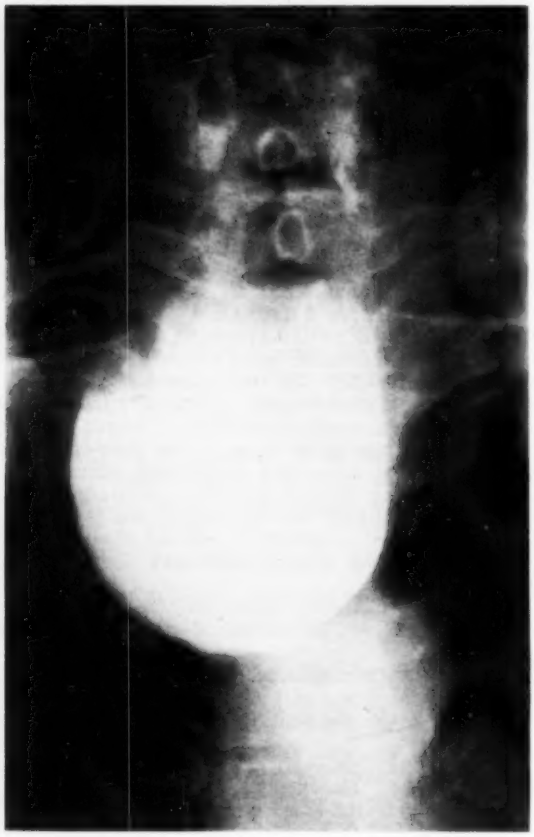

FIG. 470.—*Case* 3. Barium swallow showing pouch.

ON EXAMINATION.—A rather thin but healthy looking man. Temperature 100°.

Chest: A pleural friction rub was present in the right axillary region. Dullness and impaired air entry at the right base.

A radiograph of the chest showed right basal consolidation. He was given a course of penicillin. All signs in the chest rapidly disappeared. He was discharged after eight days and re-admitted one month later.

The barium X-ray examination was then repeated. The report was: "Large œsophageal pouch, central in position, arising about the level of C.6 and descending to the level of T.2.

"Stomach: an ulcer is seen on the lesser curvature in the lower pars media."

FIG. 471.—*Case* 3. Barium meal showing ulcer crater on lesser curvature of the stomach.

AT OPERATION (Jan. 23, 1952).—Collar incision. Approach from the right side. Pouch disected out and removed in one stage. Wound drained.

POST-OPERATIVE PROGRESS.—Uneventful. He was discharged on Feb. 15. He has been kept under observation as an out-patient and, so far, has no dysphagia or dyspepsia, although he is keeping on a 'gastric' diet.

Acknowledgements are due to Mr. N. F. Adeney and to Mr. C. E. P. Markby under whose care these cases were admitted.

ON LYMPHATIC METASTASIS FROM SARCOMA

AN AUTOPSY STUDY

BY J. B. ENTICKNAP

FROM THE DEPARTMENT OF PATHOLOGY, GUY'S HOSPITAL MEDICAL SCHOOL

SINCE the time of Virchow it has been taught that lymph-node metastases from sarcomata are uncommon, whereas it is universally accepted that in carcinomata they are the rule. It has not been the author's experience that such deposits are particularly uncommon, and a recent analysis of 1000 cases of cancer (Enticknap, 1952) has lent numerical support to this view. A survey of current editions of standard pathological text-books has revealed a diversity of opinion on this important subject, about one-third of the authors stating that sarcomatous lymph-node metastases, while less common than carcinomatous, did in fact occur with some frequency, about another third implied or explicitly stated that they were most exceptional, and the remainder did not refer directly to the subject at all. A similar

lack of uniformity was apparent when the opinions of some leading pathologists were canvassed. The subject was reviewed in 1938 by Warren and Meyer, who showed that published reports gave an incidence varying from 1 case in 69 (1·4 per cent) to 5 cases in 15 (33·3 per cent), but this paper does not appear to be widely known in this country. Their own figure of between 7 and 10 per cent was derived from 17 well-documented cases, mostly spindle-cell growths, but only 1 was a bone tumour, and 11 of the others were fibrosarcomata. They finally conclude that the probable incidence is about 7 per cent, a figure based on a collected total of 821 cases, of which 58 had metastases to lymph-nodes.

Table I.—Showing the Incidence of the Different Tumours in a Series of 1000 Cases of Cancer

	Cases	*Percentage*
Carcinomata	887	88·7
Melanomata	3	0·3
Teratomata	1	0·1
Multiple tumours	24	2·4
Cerebral tumours	39	3·9
Lymphosarcomata and reticulosarcomata	23	2·3
Thymoma	1	0·1
Other sarcomata	22	2·2

In an attempt to confirm this finding, the material available at Guy's Hospital was examined in greater detail. The incidence of the different tumours in the whole series was that shown in *Table I*, and the last group of cases in this table forms the material on which this inquiry is based.

Histological sections adequate for confirming the diagnosis were available in 21 of the sarcomata, but 1 retroperitoneal tumour has been discarded because it was thought probably to be a carcinoma arising in an adrenocortical rest. The remaining 20 form an unselected series collected over a period of approximately twenty years and can be considered to be a fair sample of the disease, although in 1 case, an anaplastic sarcoma of the stomach of uncertain cytological origin and in which no metastases at all were discovered at necropsy, death had followed shortly upon an extensive gastropancreatic resection, so that the disease had not run its full course.

Table II shows the details of these cases. The histological diagnoses have been confirmed for all primary growths and for all metastases except for those represented by the letter 'R'. For these no sections were available but the recorded description is quite convincing. This applied to only one lymph-nodal metastasis in which an anaplastic spindle-celled tumour of the fibula had metastasized widely involving many lymph-nodes throughout the body. In addition to those definitely confirmed, two of the gastric sarcomata also showed rounded encapsulated tumours in fibro-fatty tissue that were strongly suggestive of lymph-nodal metastases in, for example, the lesser omentum, but in both cases the primary tumours were large and no description of the local nodes is included in the report. In the case of fibrosarcoma of the forearm, lymph-nodal metastases are described, but the sections of the two nodes cut show only sinus catarrh—this tumour has been counted as having no lymphatic metastases although it is possible that other nodes might have shown secondary deposits.

All the sections available had been taken to confirm macroscopic diagnoses of deposits, no systematic search for microscopical evidence of metastasis having been undertaken. In most cases the nodes were

Table II.—Showing the Sites in which Metastases were found for each Tumour in the Series

	Site and Type of Primary Tumour	Skin	Myocardium	Pericardium	Thymus	Lungs	Diaphragm	Pleura	Liver	Spleen	Kidneys	Gut	Peritoneum	Retroperitoneal tissue	Uterine adnexæ	Bones	Adrenals	Pancreas, thyroid	Lymph-nodes: Local lymph-nodes	Lymph-nodes: Other nearby nodes	Lymph-nodes: Generalized spread
1.	Femur—osteogenic sarcoma					x															
2.	Pelvis—chondroscarcoma																		x		
3.	Ischium—synovioma					x								x					x		
4.	Humerus—round-cell sarcoma (? Ewing)	R									R					R			x		
5.	Rib—anaplastic sarcoma					x															
6.	Fibula—probable fibrosarcoma		R			x		x					R	R			x		R		R
	Fibrosarcoma of :—																				
7.	Forearm					x								x							
8.	Right foot	x		R		x						x	R								
9.	Lung								R												
10.	Mediastinum		R	R				R											x		
11.	Stomach								x												
	Anaplastic sarcoma of :—																				
12.	Abdomen						x		x	x		R			x				x	x	
13.	Retroperitoneal tissue											R									
14.	Orbit	x			x	x		x	x								x	x			x
15.	Bladder					x													x		
16.	Right thigh					x															
17.	Stomach												x						?		
18.	Stomach																				
19.	Angioblastoma of spleen								x												
20.	Leiomyosarcoma of stomach								x				x						?		

extensively replaced by tumour tissue. In 5 cases apparently normal nodes had, however, been sectioned, but no deposits not evident to the naked eye were detected.

It is certain therefore that 6 of these 20 cases (30 per cent) had metastasized to the local lymph-nodes at the time of death, and that in 2 more (making 40 per cent) lymph-nodes elsewhere were involved, although the ones nearest to the tumour had apparently escaped. On the other hand, there is a reasonable possibility that as many as 7 or even 9 of the cases had local metastases to lymph-nodes and 12 of them to some nodes, not necessarily the ones nearest to the primary growth. Metastasis to lungs occurred more commonly than to any other organ (47 per cent), a point which, incidentally, does suggest that these tumours are showing the typical behaviour of a group of sarcomata, but the next most common site was to the local lymph-nodes. The only other sites in which deposits were at all frequently seen were the liver (30 per cent) and the peritoneum (25 per cent), but it should be pointed out that 14 of the tumours (70 per cent) were in the catchment area of the inferior vena cava.

It is thus clear that lymph-node metastases from these sarcomata were quite common at the time of death, and the general principles of tumour pathology render it likely that they were present at the stage of the disease at which surgery might have been contemplated. The frequency of lymphatic metastasis in this series is, however, rather higher than the average of the large series collected by Warren and Meyer (1938) from the literature.

The carcinomata of the main series had metastasized to their local lymph-nodes in 44 per cent of cases, but although this figure is higher than that for sarcomata the difference does not reach conventional levels of significance (difference 14 per cent ; s.e. $\pm$ 10 per cent). If, however, this series is combined with that of Warren and Meyer (1938) (local nodal metastases present in 24 cases out of 257 = 9 per cent), the difference then becomes highly significant (difference 35 per cent ; s.e. $\pm$ 3) provided that the series are comparable.

CONCLUSION

It may therefore be concluded that while lymphatic metastasis is, as has long been known, rather commoner from carcinomata than from sarcomata, the incidence in the latter disease is by no means negligible and should be borne in mind when considering either pathological diagnosis or surgical treatment. The local lymph-nodes are second in frequency only to the lungs as a site for secondary sarcomatous deposits.

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PAPILLOMA OF THE CHOROID PLEXUS

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THE purpose of the present communication is to describe a case of papilloma of the choroid plexus of the left lateral ventricle, encountered at autopsy, and to emphasize the need for careful investigation of all cases of congenital hydrocephalus. From a study of the literature it is apparent that this neoplasm is extremely rare, and the case presented here seems worthy of record.

Cushing and Davis (1925) have described 6 cases observed over a period of fifteen years, and Cushing (1932) found only 12 cases of this neoplasm among 2023 verified intracranial tumours. Van Wagenen (1930) describes 2 cases of a true papilloma of the choroid plexus of the left ventricle and gives a valuable review of personally reported cases. Two other excellent summaries of the literature are available (Friedman and Solomon, 1936 ; Turner and Simon, 1937). Posey (1942) again reviewed the literature and with the addition of a single case, which came to autopsy, brought the recorded total at that time to 86. Walker and Horrax (1947) reported on an unusual case of papilloma of the choroid plexus with malignant characteristics and again noted that less than 100 reported cases were known. According to Van Wagenen (1930) the favourite site of these tumours is the fourth ventricle ; 50 per cent were so situated ; 34·7 per cent were in the lateral ventricle and 17·3 per cent in the third ventricle. He stated that by some curious coincidence 93 per cent of the tumours of the lateral ventricle have been on the left side. The age incidence was greatest in the first decade and gradually diminished to the sixth decade. Hall and Fentress (1933) describe a case in which the spinal dura was the primary site of a papilloma of microscopical size. Drucker (1939) found one of these tumours in a newborn infant.

CASE REPORT

A male child aged 8 months was admitted to the Royal Manchester Children's Hospital on Jan. 29, 1949. Five days prior to admission he commenced to vomit after meals and had been put on glucose and water, but was unable to retain even this. The vomit was bile-stained and had commenced to be projectile. The mother stated that for four days the bowels had not been opened and that she had noticed a pink stain on the napkin. Previous to this he had been a cheerful child, was able to sit up and to move his arms and legs vigorously. It had been

noted that at birth his head appeared to be rather large, but the mother stated that there had been no rapid recent increase in its size.

On Examination.—A markedly dehydrated ill child, with a bulging, tense anterior fontanelle. The head circumference was 20½ in. The abdomen was lax and toneless. Bilateral papilloedema was present with engorged veins and retinal hæmorrhages. The pupils reacted to light and the child took notice of objects held before him. No abnormality was detected on examination of the other cranial nerves. The arms and legs

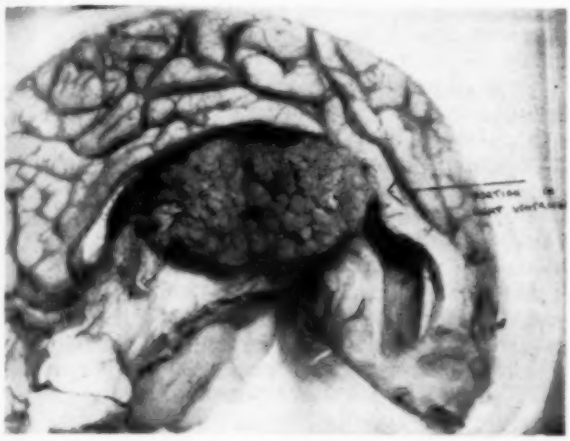

Fig. 472.—Photograph of a midsagittal section of the brain showing the papilloma of the choroid plexus in situ. The portion of the tumour projecting into the right ventricle is clearly marked.

were of normal tone, but the child showed no inclination to move them.

Pre-operative Treatment.—Bilateral subdural taps were performed to exclude a subdural hæmatoma. This examination proved negative. An intravenous drip was commenced with half-normal saline and 5 per cent dextrose at 12 drops per minute. The lateral ventricles were tapped at 2·5 cm. on either side and the pressure of the cerebrospinal fluid was found to be increased. Some slight improvement began to occur and it was decided to observe closely the condition of the child before deciding on any further treatment.

On Jan. 30, when the child was re-examined, it was found that the anterior fontanelle was still tense but that the dehydration was much less marked and some further improvement was obviously taking place. At 5 p.m. on the same day a ventricular tap was performed and 20 c.c. of cerebrospinal fluid were removed from the right lateral ventricle, but we were only able to obtain a few drops from the left ventricle. The significance of this observation was unfortunately not appreciated at the time, and it was thought that the probability was that we were dealing with a neoplasm of the posterior fossa. Ventriculography was contemplated but, again most unfortunately, decided against because at the time we had had some serious mishaps following its use in hydrocephalic infants.

At Operation.—On Jan. 31, a posterior fossa exploration was performed. The cerebellum and medulla appeared normal and it was possible to pass a soft rubber catheter 5 cm. up the fourth ventricle without meeting any obstruction. The wound was closed in the usual layers.

Repeated ventricular taps were performed but the condition of the child rapidly began to deteriorate and he died on Feb. 27.

At Autopsy.—A complete autopsy was performed by Dr. Basil Marsden and this revealed a large papilloma of the left choroid plexus.

Pathology.—

1. *Macroscopical Appearances* (*Fig.* 472).—The brain weighed 935 g. and the tumour, which was 5 cm. in diameter, was attached by a fine pedicle to the rostral portion of the left choroid plexus. The remainder of

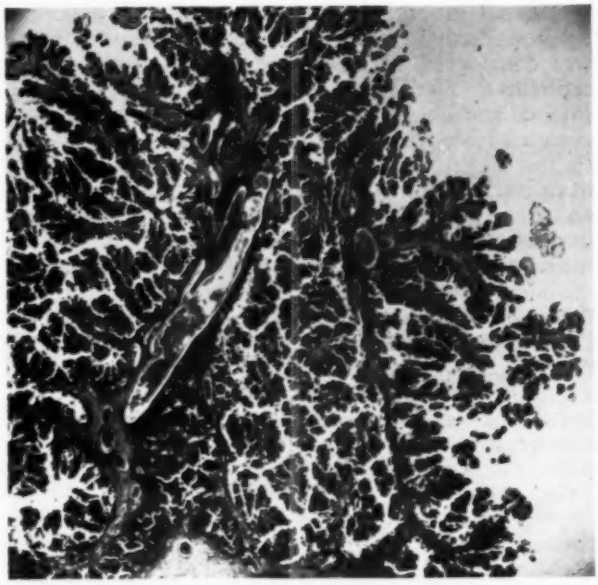

Fig. 473.—Photomicrograph to demonstrate the simple picture of the tumour. (× 20.)

the plexus was healthy. The septum lucidum was apparently destroyed and the right 'horn' of the tumour projected into the right lateral ventricle. Both lateral ventricles were dilated, the remainder of the central nervous system being healthy.

2. *Microscopical Appearances* (*Figs.* 473, 474).—The picture was a simple one of a choroidal papilloma. The

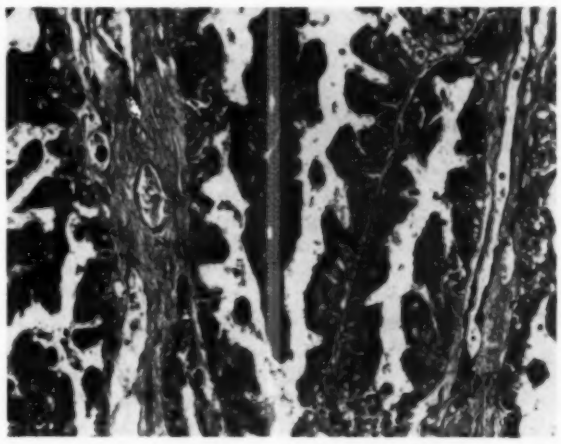

Fig. 474.—The villi of the tumour seen on greater magnification of part of *Fig.* 473. The typical plexus cells and the central cores of connective tissue are demonstrated. (× 175.)

tumour showed villi with a central core of connective tissue covered by typical plexus cells which for the most part were cuboidal in shape and arranged in single layers like those of a normal choroid plexus. 'Blepharoplasten' and glia fibres were not found in the section and their absence differentiates this tumour from an ependymoma or the rare ventricular papilloma of subependymal origin.

COMMENT

According to Posey (1942) the first clearly described case of papilloma of the choroid plexus was that of Guerard in 1832. He describes a tumour which occurred in the right lateral ventricle of a 3-year-old girl. An interesting case was described by Von Plath in 1884. The patient, aged 3 years, was considered to have died of congenital hydrocephalus. The ependyma of the ventricles was smooth and glistening. The choroid plexus of both ventricles was very thin from the foramen of Monro to the beginning of the posterior horn, where it thickened out on both sides to the size of a walnut and then tapered off again. The author considered that over-production of cerebrospinal fluid by the tumorous plexuses might have been the cause of the hydrocephalus. Hydrocephalus has been observed in half the recorded cases of papilloma of the choroid plexus. In patients of the lower age group hydrocephalus was almost always present, while in adults it was more often absent. In some cases hydrocephalus was due to obstruction of the ventricular pathways, while in others claims have been made that the tumour produced excessive fluid.

I wish to emphasize that all cases of congenital hydrocephalus require careful investigation, including the dye test and air studies. Cushing and Davis (1925) stated that it should be the ambition of the neurosurgeon to be able not only to localize a tumour with sufficient accuracy to expose it in the way most favourable for operative removal, but also, if possible, to foretell its pathologic nature, for on this the line of attack will largely depend. The same accuracy is necessary in investigating any other case of increased intracranial pressure in infants. The large majority turn out to be cases of communicating hydrocephalus, but even for these the new operations of arachnoid-ureteric anastomosis with a nylon tube (Matson, 1949) or ventriculomastoidostomy (Nosik, 1950) offer a chance of cure. In the case of obstructive hydrocephalus due to maldevelopment, puncture of the lamina terminalis and the floor of the third ventricle (Scarff, 1951) or the operation of Torkildsen (1939) may be expected to give permanent relief of pressure in 50 per cent of cases and may prevent the optic atrophy which occurs owing to the pressure of the distended third ventricle on the optic chiasma.

Other neurosurgeons, including Cushing (1925), have made the same mistake as we did, and for this alone it is well worth recording this case. We were unfortunate in being unable to make a pre-operative diagnosis for two reasons: (1) The child was extremely ill and we were of the opinion that ventriculography would weigh the balance against us. (2) We were dealing with an extremely rare tumour which we had not encountered before. If we had performed a ventriculogram and located the tumour it is doubtful whether this child would have survived an immediate operation for its removal. On the other hand, we could have used high-voltage treatment to reduce the vascularity and size of the tumour, as did Van Wagenen (1930) in one of the two cases he describes. This might have allowed us to remove it at a later date.

SUMMARY

1. A case of papilloma of the choroid plexus is reported.

2. A study of the literature reveals that this is an extremely rare neoplasm, which most frequently occurs in the first decade.

3. The need for careful investigation of all cases of congenital hydrocephalus is stressed.

My grateful thanks are due to Mr. A. N. Guthkelch for allowing me to publish this case which occurred in his Pædiatric Neurosurgical Service, and for his help and encouragement in the preparation of this paper; to Dr. Basil Marsden, who performed the autopsy; and to Mr. H. E. Ward, who was responsible for preparing the histological sections and the photomicrographs.

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ADRENAL CORTICAL CARCINOMA SIMULATING A PHÆOCHROMOCYTOMA

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CONSIDERABLE attention has been directed within the last few years to phæochromocytomas, and, now that the extremely variable clinical picture is better appreciated, more cases are being diagnosed. The condition has been well reviewed by Belt and Powell (1934), Mackeith (1944), Calkins and Howard (1947), Blacklock, Ferguson, Mack, Shafar, and Symington (1947), Bauer and Belt (1947), Cahill (1948, a), Walton (1950), and Bartels and Cattell (1950). The last-named authors consider that some 200 cases have now been reported in the literature. Malignant phæochromocytomas are extremely rare; Cross and Pace (1950) give references to only 8 cases and add a ninth.

We now report a case which clinically was diagnosed as a phæochromocytoma, although presenting certain unusual features, and which at autopsy was found to be malignant, with secondary deposits in the lungs. The microscopical appearance of the tumour, however, was not in keeping with a phæochromocytoma, but was undoubtedly that of an adrenal cortical tumour. In a review of the literature we have been unable to find any similar clinical picture produced by a suprarenal cortical tumour.

CASE REPORT

PREVIOUS HISTORY.—A male patient, born in 1918, was first seen by one of us at out-patients in 1947. We then obtained a history, which was later elaborated by Army medical records, that he had been perfectly well until 1942, when serving in India. At that time he developed pain in the left side of the chest and was in hospital for a month. A similar attack occurred in May, 1944, when an emergency appendicectomy was performed. A third identical attack of pain in the left side of the chest and back occurred in January, 1945, and a diagnosis of recurrent pericarditis was made. In March, 1945, he felt well, his blood-pressure was 112/78, but a 'pericardial rub' was reported as still present. The white-cell count was 7400, the blood sedimentation rate was 5 mm. per hour, and screening showed no significant abnormality in the heart shape except for slight unfolding of the aorta. An electrocardiogram showed sinus rhythm with slight ST elevation in leads I and IV, and slight depression in lead III. An Army medical specialist reported "dry pericarditis, with two similar attacks in the last three years—aetiology uncertain, possibly tuberculous". He was evacuated to the United Kingdom, and re-investigated in May, 1945, when his blood-pressure was 120/80 and no friction rub was heard. An electrocardiogram showed no change from the previous record. He proceeded on embarkation leave, but was re-admitted to hospital in July, 1945, with a fourth attack of pain in the left submammary region and left side of the back, severe and stabbing in nature, aggravated by coughing and breathing. There was some tenderness in the left hypochondrium, his blood-pressure was 120/70 and no pericardial rub was audible. The urine contained a trace of sugar, and the specific gravity was 1032. The white-cell count was 10,200 per c.mm. and the blood sedimentation rate 6·5 mm. in 1 hour. A radiograph of the chest, on a portable machine, showed "no pulmonary lesion, slight degree of general cardiac enlargement". The Wassermann reaction was negative. An electrocardiogram showed a negative T wave in lead III, otherwise normal. In August, 1945, he was invalided out of the Army, with a diagnosis of 'recurrent pericarditis'.

By the time we first saw him in August, 1947, he had had at least two further attacks of chest pain, treated by his own general practitioner in a cottage hospital, who stated that "the attacks came on suddenly without apparent cause or previous failing health". He described the pain as acute, and said there was quite a marked friction rub during the attack. Between attacks, the patient was said to be breathless on exertion. On examination an "extra sound" was heard before the mitral first sound, which was considered to be a form of triple rhythm. His blood-pressure was 135/105, and X-ray examination of the chest showed some generalized cardiac enlargement. The electrocardiogram showed low voltage and flat T_3, but was otherwise normal.

In June, 1949, he was admitted to our hospital complaining once more of stabbing pain in the left chest similar to previous attacks, starting in the left posterior chest and radiating around to the front, being aggravated by deep breathing. He was in good general condition, apyrexial, pulse 88, respirations 24, and blood-pressure 140/105. Again an 'impure' first heart sound was noted, but he was also thought to have a definite 'to and fro' friction sound, which became more distinct a few days after admission, although its exact nature was in considerable doubt. The urine contained no protein and no sugar. The white-cell count was 5,600, and the blood sedimentation rate 5 mm. in 1 hour (Wintrobe). A radiograph of the chest showed the lung fields to be clear, but once again there was considered to be some dilatation of the aorta. The blood Wassermann was negative, and a barium swallow and meal excluded hiatus hernia. The pain disappeared, but the abnormal heart-sound persisted. He was discharged after four weeks in hospital, diagnosed again as recurrent pericarditis of obscure aetiology.

We did not see him again until April, 1951, when he stated that since discharge he had had occasional pain in the left chest, and breathlessness on exertion associated with a sensation of tightness in the chest, and frequent vomiting. He had been at work until December, 1950, when he developed tonsillitis followed by a left-sided 'pleurisy' which lasted a few weeks. In February, 1951, he had developed a somewhat different pain in the left lower chest and left side of the abdomen, dull aching in character and lasting anything from a few minutes to a few days at a time, which had occurred frequently. He had often vomited. On the day of admission this pain had become extremely severe, and thereafter was the most prominent symptom. He had lost some weight in the previous six months, and had two days' severe headache the previous week, but otherwise had no other symptoms. A close friend told us later that the patient had often been observed sweating profusely during the previous few years.

ON EXAMINATION.—The patient was of average build, in good general condition, but obviously in severe pain

and sweating profusely. The temperature was normal. There was tenderness in the left hypochondrium and left loin, but no mass could be felt, and the liver, spleen, and kidneys were not palpable. The pulse was regular, but the blood-pressure was 200/140 (R), 180/125 (L). The mitral first sound was reduplicated, and no friction rub was heard. The lungs and nervous system, including the fundi, were normal, and there were no abnormalities of genitalia or secondary sexual characteristics.

COURSE PRIOR TO OPERATION.—He was observed and investigated over a period of 14 days, and was, for most of this time, in apparent very severe pain, unrelieved by pethidine and morphine. He sweated profusely, but remained apyrexial. The blood-pressure was found to vary from time to time from 120/90 to a maximum of 260/170, which was recorded whilst under thiopentone, nitrous oxide, and oxygen anæsthesia for cystoscopy and ureteric catheterization. The usual readings in bed were between 130/90 and 200/130.

INVESTIGATIONS.—

Urine (repeated examinations) :—

Protein—a faint trace to 0·3 g. per cent.

Sugar—nil.

Deposits—a fair number of finely granular and hyaline casts seen on one occasion, but usually nothing abnormal.

Blood-urea : 40 mg. per cent, 20 mg. per cent.

Blood-sugar (fasting before breakfast) :—

147 mg. per cent, 154 mg. per cent.

117 mg. per cent, 185 mg. per cent.

White-cell count :—

11,700 per c.mm., 18,300 per c.mm., 15,800 per c.mm. (P., 77 per cent ; L., 14 per cent ; M., 9 per cent.)

Radiography of chest : Slight cardiac enlargement. Some dilatation and unfolding of the aorta.

Straight radiograph of abdomen : No abnormality noted.

Intravenous pyelogram : Within normal limits, but left kidney is not well visualized.

Retrograde pyelogram : There was slight rotation of the left kidney, but this was considered to be within normal limits.

Electrocardiogram : Normal.

Intravenous histamine test : Negative.

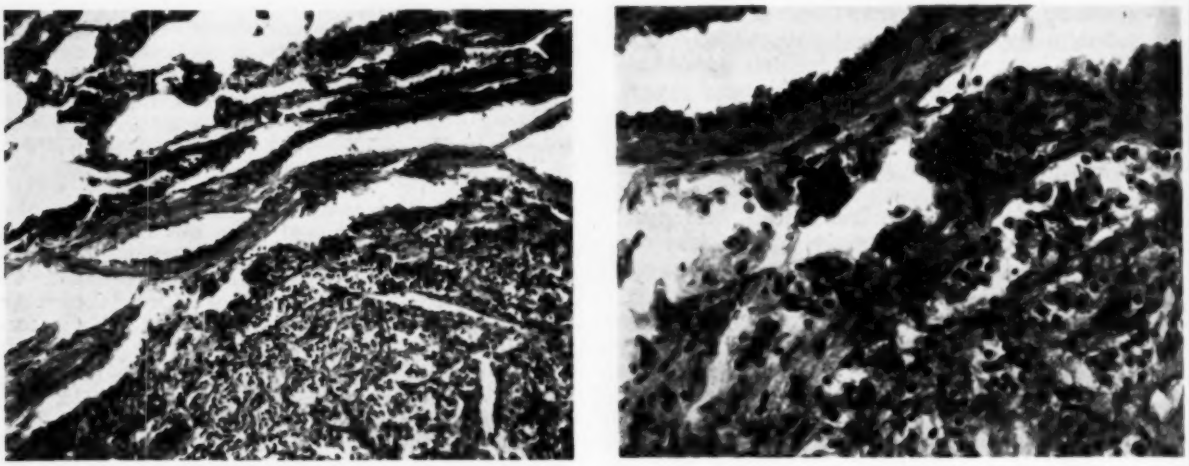
Intravenous piperoxane test : Negative.

Blood Wassermann Reaction : Negative.

Cerebrospinal Fluid : Fluid, clear. Total protein, 45 mg. per cent. Cells, 2 per c.mm. Gold curve, normal. Wassermann reaction, negative.

The intravenous histamine and piperoxane tests were against a diagnosis of phæochromocytoma, and pain as severe as this patient was suffering was not appreciated by us at that time as a recognized feature of this condition. Nevertheless, in view of the variable blood-pressure, the excessive sweating, normal temperature, raised fasting blood-sugar and leucocytosis, together with the other negative findings, a tentative diagnosis of phæochromocytoma was made, and, after consultation with our surgical colleagues, it was agreed to explore the left suprarenal region.

AT OPERATION (Mr. M. Silverstone).—Anæsthesia was induced with pentothal and flaxedil and continued with nitrous oxide and oxygen and minimal doses of pethidine. Intravenous saline and blood were given and blood-pressure readings were taken every two minutes throughout the operation.



A B

FIG. 475.—Metastasis from adrenal cortical carcinoma in congested lung tissue. A, × 76. B, × 140.

The ninth rib was excised and the pleura opened. The left kidney region was explored extraperitoneally and a large tumour found situated superiorly to the left kidney, and extending across to the midline. The tumour was dissected out with great difficulty, and could not be separated from the kidney. The kidney was therefore excised together with the tumour. Great difficulty was experienced with the medial extension of the tumour, which appeared to involve the aorta.

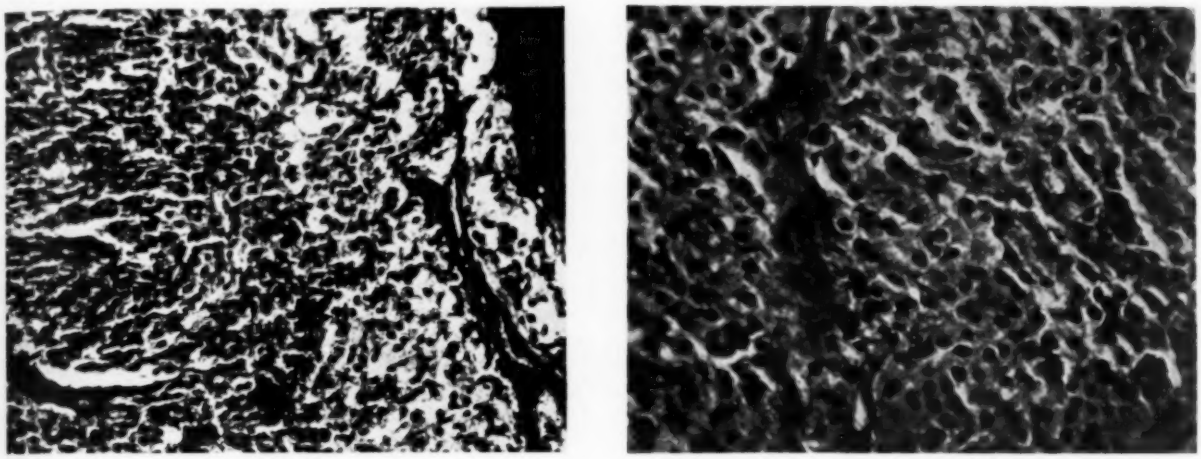
At the commencement of the operation the blood-pressure was 210/170, with a pulse-rate of 120 per minute. Throughout the operation the diastolic pressure gradually rose towards the systolic and the pulse-rate increased. The injection of piperoxane (5 c.c. ; 10 mg.) on several occasions had no effect on the blood-pressure, which was finally recorded as 210/200 about an hour after the commencement of operation. It thereafter became unreadable, although the pulse was palpable at about 180 per minute for 15 minutes longer. The patient died a few minutes after the removal of the tumour, and attempts at resuscitation with cardiac massage, adrenaline, methedrine, and nikethamide were useless.

AT POST-MORTEM EXAMINATION.—The significant findings were as follows : A considerable number of small nodules scattered throughout both lungs about 3-6 mm. in diameter. Section showed these to be foci of malignant cells indistinguishable from those found in the more cellular parts of the primary tumour. (*Fig.* 475.) Apart from lymph-glands adjacent to the primary tumour, no other secondary deposits were found. The right suprarenal showed no macroscopical or microscopical abnormality. The kidneys, heart, and other organs

were also normal. There was no evidence of past or present pericarditis.

DESCRIPTION OF THE TUMOUR REMOVED AT OPERATION.—

Macroscopically the tumour was oval and measured 13 × 6 × 7 cm. It seemed to be encapsulated, though the capsule did not appear to be complete. It weighed 396 g. Its cut surface showed a variegated appearance, yellowish translucent areas alternating with areas of necrosis, areas of hæmorrhage, and areas in which the tissue was soft and greyish in appearance.



A B

FIG. 476.—The primary adrenal tumour. A, × 140. B, × 262·5.

Microscopically the tumour was highly vascular, showing extensive areas of necrosis together with cellular areas traversed by fibrous tissue septa. The cells in these areas were suggestive of rather bizarre suprarenal cortical cells, a number of them showing a vacuolated eosinophilic appearance with small round nuclei, but others were more foamy in appearance and were suggestive of the cells found in a hypernephroma. Mitotic figures were not common (*Fig.* 476).

The hospital pathologist considered the appearances were not those of a phæochromocytoma, but more of an adrenal cortical carcinoma, or possibly of renal origin (*Fig.* 477).

The chromaffin reaction carried out by the method described by Carleton and Leach (1938, a) gave a negative reaction.

An attempt to demonstrate adrenaline histologically by the technique devised by Dr. W. Cramer (Carleton and Leach, 1938, b) proved unsuccessful, and negative results were obtained when the Vulpian reaction was carried out on an extract of the fresh tumour tissue prepared according to the method described by Hawk and others (1947).

The sections were subsequently examined by two Professors of Pathology, and both independently expressed the view that the structure of the tumour was that of an adrenal cortical carcinoma. One stated: "Compact clumps of cells in many parts and their vacuolated appearance closely resemble what are seen in the ordinary small cortical adenomas, and nowhere does the tumour show the diffuse pleomorphic-cell structure which is more characteristic of chromaffin tumours".

DISCUSSION

Comprehensive reviews of adrenal cortical tumours have been made by Kepler and Keating (1941), Cahill, Melicow, and Darby (1942), Kenyon (1944), Cahill (1948, b), Phillips and Ray (1949), Walters and Sprague (1949), and Cahill and Melicow (1950). The clinical pictures described can be classified as follows:—

a. Adrenogenital syndrome;

b. Cushing's syndrome;

c. A mixture of adrenogenital and Cushing's syndromes;

d. Feminizing syndromes;

e. Single or isolated endocrine manifestations (mentioned only by Kenyon);

f. Non-hormonal tumours.

It is clear that our case does not fit into any of these groups, but the close correlation of many of its features to those described as occurring in phæochromocytomata is remarkable, and has prompted us to publish this single case.

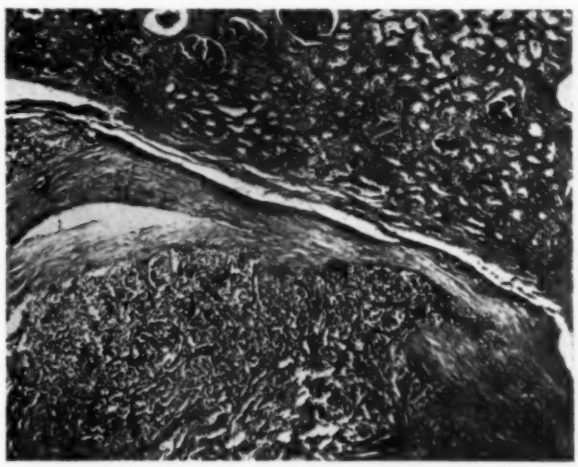


FIG. 477.—Section showing clear demarcation between primary adrenal tumour and renal tissue. (× 48.)

Duration of Symptoms.—In retrospect, it seems fair to assume that the symptoms experienced in 1942 were due to the tumour, particularly as during investigations prior to discharge from the Army in

1945 there was tenderness in the left hypochondrium, glycosuria, and the white-cell count was 10,200 per c.mm. Furthermore, at autopsy there was no evidence of past or present pericarditis—the diagnosis on which he was invalided out of the Forces.

A considerable number of cases of phæochromocytoma have been reported where it is certain that the tumour has been present for over ten years; one of Bartels and Cattell's (1950) cases first developed symptoms twenty-one years before being correctly diagnosed. Although some of the non-hormonal cortical tumours may well have been present for this length of time before diagnosis, most of the active cortical tumours have been diagnosed within a much shorter interval from the onset of the first symptom.

Pain.—Mild epigastric or retrosternal pain is common in the paroxysms of hypertension with phæochromocytomas. Severe pain, however, is a rarity in this condition, although Gilliland and Daniel (1951) report a case presenting as an abdominal emergency with excruciating abdominal pain radiating from the left flank. They suggest that hæmorrhage into the tumour is responsible for much of this symptom, and yet Lumb (1950) reports two enormous non-hormonal adrenal cortical tumours weighing 3750 g. and 5350 g. respectively, in which there was considerable hæmorrhage and necrosis but no pain. Non-hormonal cortical tumours, however, usually present with dull pain, presumably due to pressure on surrounding structures.

In our case there was considerable hæmorrhage into the tumour and it was also adherent to rib, aorta, and kidney, and all these factors were probably responsible for the intense, unusual, unrelievable pain which the patient experienced in his final exacerbation.

Paroxysmal Hypertension.—As pointed out by Bauer and Belt (1947), paroxysmal hypertension has been observed not only in phæochromocytoma but also in eclampsia, lead poisoning, essential hypertension, nephritis, aortitis, epilepsy, traumatic and vascular damage to the brain, meningitis, tabes, diseased Gasserian ganglion, sciatic neuritis, compression of the vagus by tumour mass, typhoid and other acute infectious fevers, and even in a case allergic to Madeira wine. There is, however, no mention in this comprehensive list of suprarenal cortical tumours, but we find that Oppenheimer and Fishberg (1924) give references to 9 cases of hypertension in suprarenal cortical tumours, some of which could be regarded as paroxysmal. Plazy and Germain (1932) report a case of extensive aortic atheroma and aneurysm with bilateral suprarenal cortical tumours where there were two paroxysms of hypertension. Rimbaud and Delmas (1939) also describe a case of suprarenal cortical tumours in a man aged 57 with four paroxysms.

Paroxysmal hypertension has been reported with adrenal ganglioneuroma (Rogers, 1933) and with neuroblastoma (Ernould and Picard, 1934).

Demole and Rutishauser (1939) describe a particularly interesting case of paroxysmal hypertension in a patient who ultimately proved to have tuberculous destruction of the left adrenal gland. The fasting blood-sugar level was also variable in this case (100–170 mg. per cent), and transfusion of the patient's blood into a normal recipient produced an elevation of blood-pressure and blood-sugar level lasting for ten minutes.

McGavack, Benjamin, Speer, and Klotz (1942) report a case of malignant phæochromocytoma simulating a carcinoma of the adrenal cortex with secondary adrenal insufficiency, and, in reviewing the previously described malignant cases, point out that paroxysmal hypertension does *not* occur in malignant phæochromocytomas. Cross and Pace's (1950) case, however, proved an exception.

Of special interest in our case was the rise to 260/170 under thiopentone, nitrous oxide, and oxygen anæsthesia. The reading was taken before cystoscopy was undertaken and there was no suggestion of anoxia at the time.

It seems fairly clear that the mechanism of paroxysmal hypertension in phæochromocytoma is the release of adrenaline and noradrenaline. The effect of these substances on the human circulation has been studied by Goldenberg and others (1948) and Swan (1949). The exact cause of paroxysmal hypertension in conditions other than phæochromocytoma is a matter for speculation. In some cases it may be due to secondary adrenal medullary stimulation with the release of adrenaline substances, but it seems probable that in others, and perhaps in our case, invasion of, or pressure upon, the sympathetic nerve-plexuses and chain may have been a factor. Other pressor substances may be involved.

Excessive Sweating.—This was a marked feature in our case and is commonly found in cases of phæochromocytoma. It has not been observed as a special feature in cortical tumours.

Variable Fasting Blood-sugar is a very useful pointer to the diagnosis of phæochromocytoma, and a number of cases present as diabetes. Goldner (1947) reports a case where the diabetes cleared up after removal of the tumour.

A similar case is also reported by Duncan, Semans, and Howard (1944). Hyperglycæmia is commonly associated with Cushing's syndrome, but tends to be a constant finding rather than variable, as in our case.

Leucocytosis is also a common finding in phæochromocytoma, and was present in our case, varying from 10,000 to 18,000 per c.mm. It may, of course, be seen wherever a tumour is present and undergoing necrosis, but is not so commonly found in adrenal cortical tumours as in phæochromocytomas.

Sexual Changes.—One of the most outstanding features of our case is that there were no sexual changes, either in sexual activity or secondary sexual characteristics. We have not found any report of cortical tumours which can be regarded as hormonally active, without such changes. The adrenogenital syndrome and Cushing's syndrome, or a mixture of these, are relatively common; the feminizing syndromes are much rarer. Armstrong and Simpson (1948) describe a case, and review only 8 previously reported cases.

The Histamine and Piperoxane Diagnostic Tests.—Bartels and Cattell (1950) review the various diagnostic tests for phæochromocytoma and point out, contrary to some earlier writers, that a negative histamine test does not exclude the condition. However, it does appear to have been positive in the

majority of cases, and our negative result considerably disturbed our confidence in the pre-operative diagnosis. It is of interest that the test should have been negative with a cortical tumour producing paroxysmal hypertension, when it is so frequently positive with medullary tumours.

The piperoxane test was unlikely to be of much value, as the resting blood-pressure was low at the time that the test was carried out.

Cause of Death.—The difficulties of controlling the blood-pressure during operations on phæochromocytomas, and the likelihood of post-operative shock after removal of any form of adrenal tumour are well known, and described in detail by many of the above-mentioned authors. The curious way in which there was a progressive rise of the diastolic pressure with a stationary systolic pressure throughout the operation was another very unusual feature about our case. The pulse pressure at the start was only 40 mm. Hg, and for a considerable time before death was only 10 mm. These figures, together with the complete lack of response to piperoxane, also suggest that adrenaline was not the cause of the hypertension.

In conclusion, we can say that, even after a careful reconsideration of the clinical features, the diagnosis of phæochromocytoma was well justified. It is interesting to note that in spite of the size of the tumour, and a diligent search for it on clinical examination, it could not be palpated, nor did it produce any recognizable abnormality in the retrograde pyelogram. The fact that the tumour turned out to be a cortical carcinoma explains some of the anomalous findings, but makes it an even more unusual and fascinating clinical study, and leaves a number of problems unsolved. It is an aphorism that we diagnose what we know, and we hope that the above review of the extremely variable features of suprarenal tumours may help others, as it has helped us, to appreciate the possibility of these diseases when they present themselves in their various guises.

SUMMARY

1. A case is described of a man, aged 33 years, presenting many features of a phæochromocytoma, including paroxysmal hypertension, a variable hyperglycæmia, and leucocytosis.

2. Excruciating pain was the most significant symptom.

3. Symptoms had been present for nine years, and he had previously been diagnosed as a ' recurring pericarditis '.

4. At laparotomy a left suprarenal tumour was found and removed. Histologically, this appeared to be a suprarenal *cortical* carcinoma, and small secondary deposits were found throughout the lungs. There was no evidence of pericarditis or renal damage.

5. Death occurred during operation, following a progressive rise of the diastolic blood-pressure, which finally approximated to the systolic pressure.

6. The main features of this unusual case are discussed in relation to previous cases found in the literature.

We wish to express our thanks to Mr. L. R. Broster for his advice and encouragement; to Mr. M. Silverstone for permission to publish his operative findings; and to Dr. H. Maclean for the pathological data.

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GARGOYLISM

REPORT OF A CASE

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THE term ' gargoylism ' was coined by Ellis and his associates in 1936 to describe a familial and progressive metabolic disorder of unknown aetiology. Sometimes referred to as Hurler's syndrome (1920), it was first described in 1900 by Dr. John Thompson, who presented 5 cases from the Royal Edinburgh Hospital for Sick Children. A repulsive hideousness of the face and grotesque dwarfism (an appearance described by Thompson as ' uncanny '), are notable clinical features. The main pathological abnormality is the presence of an abnormal storage material in the cells of nearly all the systems ; this was formerly thought to be a lipid, but more recent work suggests that it may be a carbohydrate. As a result of the abnormal metabolism, a large variety of anomalies supervene, and death often occurs suddenly—a characteristic of the condition—at about 5 or 6 years of age.

The word ' gargoylism ' has been accepted in medical literature, but it is doubtful whether this terminology is altogether suitable. The brutish physiognomy bears a superficial resemblance to the effigies in stone, but here it ends, because the medieval freemason sculptured a mischievous, alert fellow, in the full possession of his faculties, and ready for any devilment. In actual fact many of the architectural gargoyles depict animals and not humans. Other synonyms are ' lipochondrodystrophy ' and ' dysostosis multiplex '. The former should now be abandoned.

Since the earlier writings of Hunter (1917) and Hurler (1920) much has been added to the literature of this subject, although the aetiology is still unknown. Ellis, Sheldon, and Capon (1936) reported 7 personal cases and reviewed the literature. They considerably clarified the syndrome as a clinical entity, and from that time on, as a result of careful analysis of clinical, radiological, and histopathological findings, a clearer conception of the disease has resulted. Confusion arose because of the unequal extent to which various systems are involved, and it has now become apparent that as most cells in the body are involved in varying degree, so variations will occur in the clinical findings. Ellis and others note that the children are amiable—a finding that is frequently contradicted by other writers. They found no greater abnormality in the blood-chemistry than might be expected as a result of involvement of the liver. They were rightly cautious in attributing the condition to an upset of lipid metabolism, and suggested that some of the clinical findings were due to involvement of the pituitary gland. This may be implicated in two ways—first, by the presence of the storage material ; and, secondly, by distortion of the gland from alteration in the shape of the sella turcica. (This is described elsewhere in this report.) Articles by Jewesbury and Spence (1921), and Smith, Hempelmann, Moore, and Barr (1952) also discuss this aspect. It is now generally agreed that Tuthill's (1934) interpretation of the histopathological findings is incorrect, and that the condition is not related to juvenile amaurotic idiocy, as he thought.

The histopathological findings in the central nervous system were given in detail by Ashby, Stewart, and Watkin (1937). This article demonstrates that the central nervous system may be involved in varying degree, and while in their case it was heavily involved, the case reported here shows little or no evidence of the storage material in this system. They place the disease among the lipoidoses and associate it with juvenile amaurotic idiocy.

Kressler and Aegerter (1938) also indicated that gargoylism was a storage disease of the lipoid type. They considered that the changes in the central nervous system were analogous to Niemann-Pick's disease and juvenile amaurotic familial idiocy. It is surprising that none of the tissues examined by them showed positive staining reaction for carbohydrates.

Henderson and Ellis (1940) made a notable contribution to commemorate Dr. John Thompson, of Edinburgh. They described 5 personal cases and reviewed 57 from the literature. A full account and bibliography was given. They considered gargoylism to be a lipoidosis.

De Lange, Gerlings, de Kleyn, and Lettinga (1944), quoted by Lindsay, Reilly, Gotham, and Skahen (1948), and Strauss (1947) suggested that the storage material was a carbohydrate.

Lindsay and his associates made an important contribution in 1948. They gave detailed autopsy reports of 8 cases and the results of surgical biopsy in 4 cases more. They reviewed the subject thoroughly and supported the view that the storage material was a carbohydrate. The characteristic cellular change was a swelling of the cytoplasm. Many cells—epithelial and mesothelial—were affected by this storage material, which was most abundant in the liver. The widespread cellular deposit ultimately involved the skeletal system, causing such changes as stunting of the growth and so on. Two types of cellular reaction were described—first, the clear vacuole, and, alternatively, a granular deposit in the cytoplasm. The cell envelope was thinned and the nucleus pushed to one side. They suggested that the abnormal material was glycogen or glycoprotein. One hundred and seven cases were collected from the literature by Reilly and Lindsay (1948). This article discussed the biochemical aspects of the condition and described the changes in the cornea and middle and inner ears.

Two adult cases and one autopsy were described by Smith and others in 1952. They suggested that the disease should be called either Hurler's syndrome or ' dysostosis multiplex '. They considered that the changes in the sella turcica were distinctive and

pathognomonic of the condition. This report is interesting in that the patients reached adult life. Several other papers have mentioned adolescent and adult cases (Straus, Merliss, and Reiser, 1947; de Lange and others, 1944; Sawyer, 1945). Smith and others support the carbohydrate storage theory and think that the stored material may be glycogen or a related substance.

The trend of opinion therefore places gargoylism in the group of metabolic diseases distinguished by the abnormal storage of products of metabolism, comparable with the lipoidoses (Gaucher's disease, Niemann-Pick's disease, Schüller-Christian's disease, and amaurotic juvenile familial idiocy), and having features in common with them. In the case of gargoylism the abnormal material is a carbohydrate—possibly a glycoprotein, although this still awaits definite proof.

The relationship with the glycogen storage disease described by von Gierke is indefinite.

CASE REPORT

The subject of this report was a fully developed gargoyle who was observed from time to time from his birth to his sudden death at 6 years of age.

FAMILY HISTORY.—The parents were alive and well and of Italian extraction. The mother was of an extremely low mentality. A brother and sister were normal. Pregnancy and parturition were normal, and the birth weight 8 lb. 5 oz. As far as could be ascertained there was no previous history of gargoylism in the family.

EXAMINATION AT BIRTH.—There was a hare-lip and cleft palate. Apart from this he seemed to be normal.

PROGRESS.—During the first few years of life he was frequently admitted to hospital with respiratory infections. The hare-lip and cleft palate were successfully treated surgically, but bilateral scrotal herniæ and an umbilical hernia recurred after operation. On one occasion the hospital notes described him as a "happy child, who smiled when examined." His habits were dirty. Gargoylism was diagnosed at 3 years of age.

In 1951 he was admitted to hospital with a pathological fracture of the left femur, the result of a trivial twist. The limb was splinted, and he died suddenly one month later.

EXAMINATION.—He was a good but slow eater. He was unable to feed himself, had never walked, and

FIG. 478.—Post-mortem photograph. The appearance is typical of gargoylism.

growth was stunted. He was blind, deaf, an imbecile, and doubly incontinent. He spent the day huddled in a chair, and the large head, stunted trunk, and protuberant abdomen, associated with the ugliness of the features, combined to give an almost subhuman appearance (*Fig.* 478).

The head was scaphocephalic in shape and set on the trunk by a short neck. The hair of the head and eyebrows was coarse and dark. The eyes were widely separated and the cornea opaque. He seemed to be unable to appreciate light. The bridge of the nose was sunken and broad, and the nostrils large and set widely apart. A mucopurulent discharge appeared constantly from the nose. The ears were set low in the skull and he was completely deaf. The mouth was large and the lips coarse and everted. The teeth were peg-shaped, widely separated, and carious, and the lower jaw was large. The tongue was coarse and too big for the mouth,

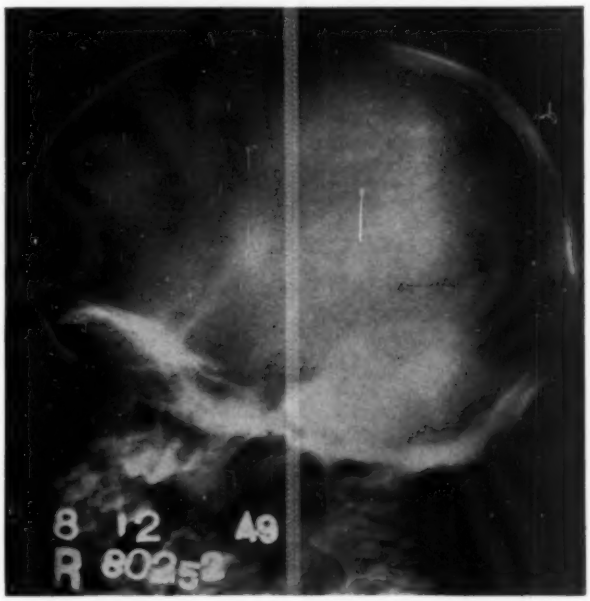

FIG. 479.—The vault of the skull is normal. The orbital plates are high and the sella turcica shows the characteristic deep anterior pocket.

and was constantly protruded. He was unable to talk, but uttered a few unintelligible sounds.

The trunk was stunted, and the chest cage was short, broadened, and shallow. He was unable to sit up, and slouched forwards, a position which gave rise to an obvious dorsolumbar spinal kyphosis. The abdomen was protuberant, partly as a result of his posture and partly from enlargement of the liver and spleen. There were umbilical and scrotal herniæ. The genitals were small.

The upper limbs were shortened and broadened, especially the forearms and hands. The ring and little fingers were incurved. There was a tendency to flexion contracture of the joints, and abduction movement of the shoulders and extension movement of the elbows were limited.

The lower limbs were weak and underdeveloped. The hips were stiff, particularly abduction movement. The knees were relatively enlarged, and had flexion contractures. The feet were normal and the toes clawed. The fracture of the shaft of the left femur was of the ordinary spiral type, and was clinically firm after one month's splinting.

RADIOLOGICAL APPEARANCE.—Radiographs were taken in 1949 and were not repeated.

Skull.—The calvaria was normal and there was no hydrocephalus. The sella turcica showed the characteristic anterior pocketing (due probably to abnormalities in the development of the ethmoids and sphenoid) that is said to be pathognomonic of the condition (*Fig.* 479). The lower jaw was enlarged, and the teeth germs were normal.

Trunk.—The spine showed the characteristic globular-shaped vertebral bodies. The upper and anterior aspect of the body of the first lumbar vertebra was deficient, and the lower part represented by a prominent beaklike process. This was the site of the kyphosis (*Fig.* 480).

FIG. 480.—Lateral radiograph of the spine. The kyphosis and characteristic beak-shaped process of the first lumbar body is shown. The remainder of the vertebral bodies are ovoid. Note the clubbing of the ribs.

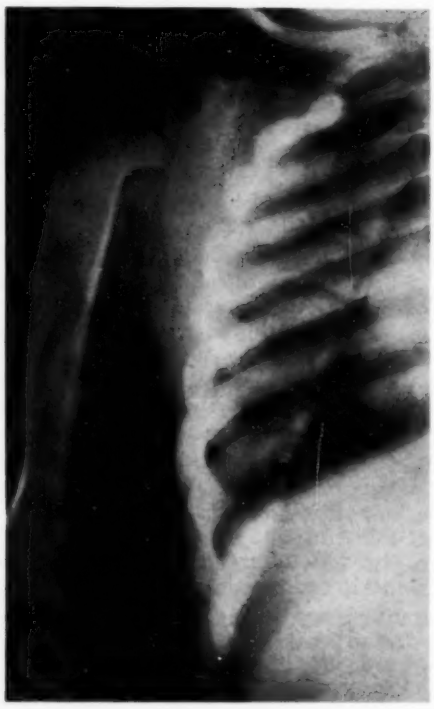

FIG. 481.—The humerus shows the characteristic angling of the surgical neck, and stunting and expansion of the shaft.

FIG. 482.—The hands show expansion of the metacarpals and phalanges. The bones are atrophied and the cortices thinned.

FIG. 483.—The hips showing the widening of the acetabula. The femora have a 'blunderbuss' appearance and growth lines are clearly seen. The knees have a normal appearance.

The ribs were club-shaped at their sternal ends (*Fig.* 480).

Shoulder Girdle.—The sternal ends of the clavicle were expanded, and the scapulæ were normal.

Humeri.—The upper ends were angled, and the upper shaft expanded. The lower ends were globular in shape (*Fig.* 481).

Forearm and Hand Bones.—A radiograph was taken post mortem, and it showed proximal and distal expansion of the shafts of the radius and ulna and inward sloping of the distal extremities of the bones. The metacarpals were expanded and the cortices thinned. The proximal ends were pointed. (*Fig.* 482.)

Pelvis.—This was normal, except for the acetabula, which were widely expanded. The femoral heads were raised slightly but not dislocated (*Fig.* 483).

Femora.—They showed a remarkable ' blunderbuss ' appearance by the expansion of the distal ends. The epiphyseal plates were normal. The spiral fracture of the left femur showed normal callus formation (*Figs.* 483, 484).

Tibiæ.—These were normal except for a forward sloping of the upper tibial epiphysis, probably from attempts to extend the knees.

FIG. 484.—The spiral fracture of the left femur, showing good callus formation.

A feature of many of the shafts of the long bones was well marked ' growth lines ' (*Fig.* 483). The epiphyses when present were generally well formed, but their growth was retarded. The patella was entirely cartilaginous.

POST-MORTEM EXAMINATION (13 hours after death).—The body presented the characteristic external features of gargoylism described above (*see Fig.* 478).

Examination of the organs revealed considerable macroscopic abnormalities in all systems.

The heart weighed 120 g. and appeared somewhat pale and flabby. The valves were all uniformly thickened, although they remained soft and pliable and were not adherent. No vegetations were present. There were a few tiny yellow streaks in the intima of the ascending aorta, but the remainder of the vascular system appeared normal.

The pleural cavities were both obliterated by old fibrous adhesions. The trachea and bronchi were slightly congested and contained a quantity of sticky mucus. No abnormality was seen in the lung parenchyma.

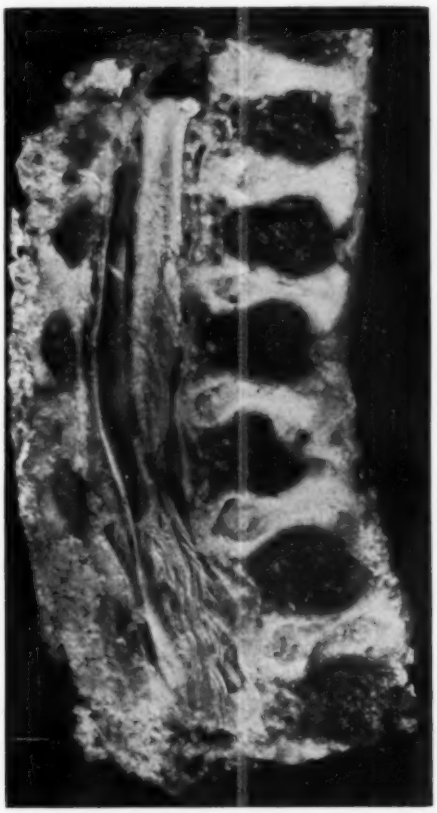

FIG. 485.—Sagittal section of the spine at the dorsolumbar kyphosis. The vertebral bodies are ovoid and the first lumbar vertebra shows the characteristic beak-shaped projection. The intervertebral disks are thick and the nucleus pulposus is displaced backwards.

In the mouth there was evidence of previous surgical repair of the cleft palate. The teeth were widely spaced, peg-shaped, and projected only a short distance from the gum margin. There was gross dental caries.

The bowel appeared macroscopically normal, although the mesentery was unduly long, and the cæcum and ascending colon had not undergone zygosis.

The liver weighed 720 g. The shape was somewhat unusual in that the organ was flattened. It was increased in lateral extent, and the right extremity was folded around the body wall so that it came to lie posterior to the gall-bladder. The cut surface was pale and smooth and the organ had a rubbery consistency.

The gall-bladder and pancreas appeared normal.

There was considerable enlargement of the spleen, which weighed 230 g. The cut surface appeared somewhat pale and was firmer than normal.

There was generalized enlargement of all the lymph-nodes.

There was a hydrocele on the right side, but otherwise no macroscopic abnormality in the organs of the genito-urinary system.

FIG. 486.—Section through the head of the humerus. The capsule and periarticular tissues are thickened. The articular cartilage is mottled and the centre of ossification small. Note the typical angling of the neck of the humerus and coarse medullary bone.

FIG. 487.—Section through the elbow, forearm, and wrist. The elbow is shallow. The radius and ulna show proximal and distal expansion. The ulna is short and the distal extremities of the bones slope inwards.

FIG. 488.—The hand. The sloping distal extremities of the radius and ulna are well shown. The centres of ossification have not appeared. The centres for the carpals are considerably late. The metacarpals are expanded and pointed at their proximal extremities. All the articular cartilage is mottled. Note the characteristic incurving of the ring and little fingers.

FIG. 489.—Section through a hip-joint. The acetabulum is widened and the alteration in the shape of the femoral head is shown. The ligamentum teres is a bulky structure. The articular cartilage is coarsely mottled and the centre of ossification for the femoral head has not appeared. The periarticular tissues are greatly increased in bulk.

Apart from some enlargement of the pituitary gland, the endocrine organs appeared normal to the naked eye. No macroscopic abnormality was evident in the brain.

FIG. 490.—Cross-section through the fracture of the shaft of the left femur shows that normal callus has formed and union is firm.

Skeletal System.—The spine, shoulder, and elbow-joints, the forearm bones and the hands, the hip-joints and knee-joints were sawn longitudinally and examined.

Spine.—The dorsolumbar area only was examined (*Fig.* 485). There was a great increase in the connective tissue of the intervertebral disks, and the vertebral body was ovoid in shape. The nucleus pulposus was displaced backwards. The anterosuperior aspect of the first lumbar body was deficient and replaced by fibrous tissue. The lower part of the body formed a beak-shaped process. Dr. C. Begg, of the Department of Radiology, Dunedin Hospital, has suggested that the kyphosis was mechanical in origin, being due to the huddled position adopted by the subject during the day, and aided by alteration in the shape of the chest cage, the protuberant abdomen, and excess of connective tissue in the disk. This abnormal pressure probably resulted in absorption of the upper part of the vertebral body. The posterior elements of the vertebral body appeared to be normal.

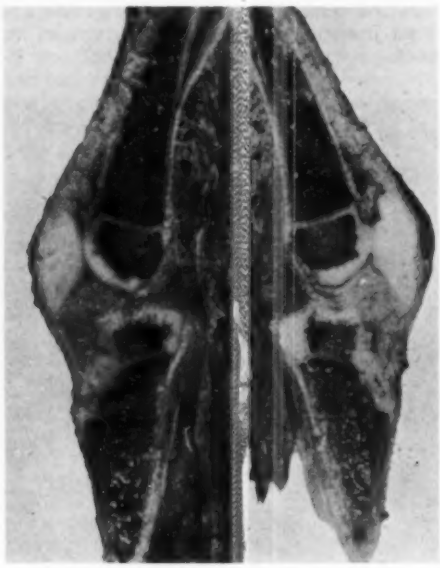

FIG. 491.—Section through a knee-joint. Well-marked growth lines in the shafts of the bones are seen. The centres of ossification are quite well developed and the epiphysial plates appear normal, except for the forward slope of the tibial epiphysis. The patella is comprised of mottled cartilage with no centre of ossification.

Shoulder-joints.—The glenoid fossæ were tiny. The humeral heads were large, and composed of a mottled hyaline cartilage; the centres of ossification were retarded. The joint capsules and periarticular tissues were gelatinous and greatly thickened, particularly on the inferior aspect, where they are normally thin and lax. The surgical necks

FIG. 492.—Cortical bone and periosteum from femoral shaft, showing swelling of osteocytes and fibrocytes (formalin-fixed tissue, H. and E. stain).

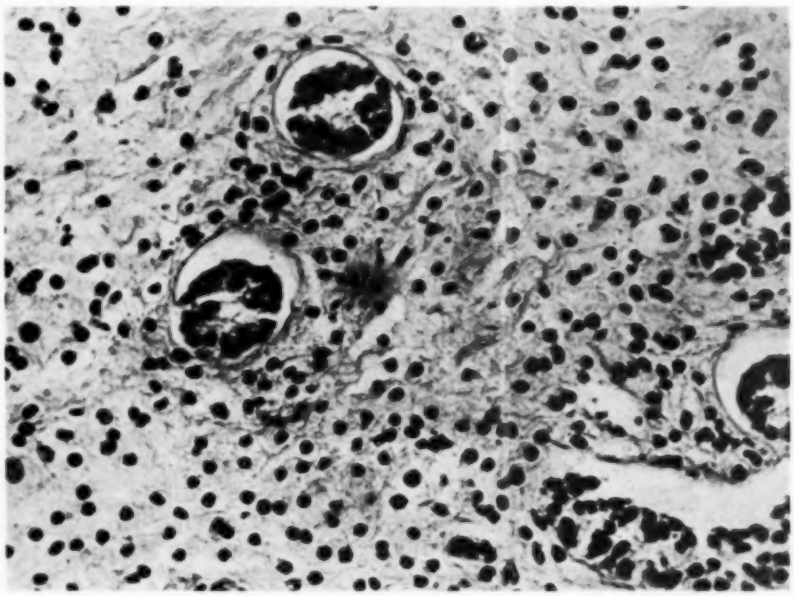

FIG. 493.—Connective tissue of testis, showing swelling and vacuolation of cells (formalin-fixed tissue, H. and E. stain).

of the humeri were angled, resembling those of the femur (*Fig.* 486). This combination would undoubtedly limit abduction movement during life.

Forearms.—The proximal and distal extremities of each radius and ulna were expanded (*Fig.* 487), and there was also an inward inclination of the carpal aspects of these bones.

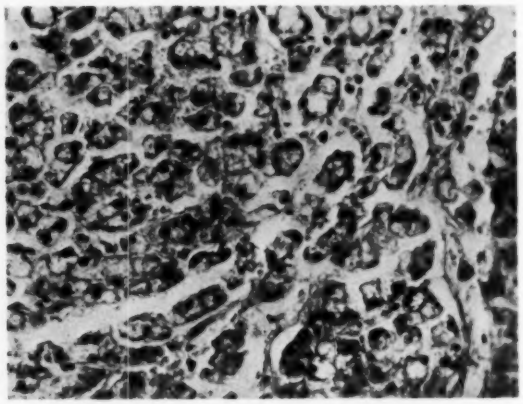

FIG. 494.—Liver, showing swelling and vacuolation of parenchymal cells (formalin-fixed tissue, H. and E. stain).

Carpal Bones.—These were composed of mottled hyaline cartilage. The centres of ossification were either retarded or absent (*Fig.* 488).

Metacarpals.—These were expanded, and the cortices were considerably thinned. The proximal extremities

FIG. 495.—Localized areas of vascular connective tissue within articular cartilage of femoral head (formalin-fixed tissue, H. and E. stain).

were pointed (*Fig.* 488). The phalanges were likewise expanded. These findings confirmed the X-ray appearances.

Hip-joints.—The acetabula were widened from an excessive amount of mottled hyaline cartilage, and the triradiate epiphyses were broader than usual. Each ligamentum teres was thickened and occupied a large depression in the femoral head. This ligament was so bulky that it tended to sublux the hip. The outer aspects of the femoral heads were flattened. The capsule and periarticular tissues were enormously thickened, and, in conjunction with the shape of the femoral heads, would have considerably restricted hip movement during life (*Fig.* 489).

Femoral shafts.—These were expanded at their distal extremities and the fracture of the left femur had formed normal callus (*Fig.* 490). Coxa valga, from disuse, was present.

Knee-joints.—The ossific centres were well formed (*Fig.* 491). The upper tibial epiphysis sloped forwards, and the patella consisted of a bulky mass of mottled hyaline cartilage with no ossific centre. The periarticular tissues were not so grossly hypertrophied as in the hips, but a tightness at the back of the knee caused the limitation of extension despite the shape of the upper tibial epiphysis.

HISTOLOGICAL EXAMINATION.—Tissues for routine examination were fixed in Kaiserling's solution, embedded in paraffin and stained with hæmatoxylin and eosin (H. and E.), and van Gieson's stain. Selected tissues were fixed in alcohol and likewise embedded in paraffin. These were stained with H. and E., Best's carmine, and

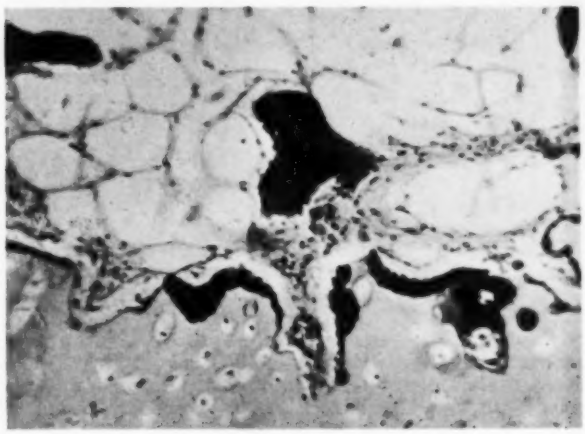

FIG. 496.—Femoral head, showing poorly formed, irregular cortical bone (formalin-fixed tissue, H. and E. stain).

periodic acid followed by Schiff's reagent. Frozen sections were cut from the liver and stained for fat.

In H. and E. and van Gieson stains, the striking lesion was swelling of the cytoplasm of a variety of cells. The inclusion substance was represented by large clear vacuoles which appeared to have displaced the cytoplasm to the rim of the cell. This change was seen consistently in the connective-tissue cells of every organ, although in some areas it was more striking than in others, notably in the periosteum and insterstitial tissue of the testis. The cytoplasmic swelling of the fibrocytes was frequently accompanied by hyalinization of the collagen. In many places the connective tissue was increased in amount, although to a certain extent this increase may have been apparent owing to swelling of the cells and hyalinization of the fibres. These connective-tissue changes were responsible for the thickening of the heart valves and also for patchy intimal thickening seen in many arterioles in the parenchymal organs. There was a diffuse increase in connective tissue in the medulla of the kidney, and to a lesser extent in the other parenchymal organs. *Figs.* 492 and 493 show swollen fibrocytes in the periosteum and interstitial tissue of the testis.

Similar cytoplasmic swelling was seen in the chondrocytes and osteocytes.

This storage phenomenon was not restricted to the connective tissues. The epithelial cells of the liver (*Fig.* 494), thyroid, and pituitary showed well-marked cytoplasmic vacuolation, and occasional myocardial fibres were vacuolated or granular.

The endothelial cells lining the sinusoids of the spleen and lymph-nodes were distended with clear

material. A number of similar large vacuolated mononuclear cells were present in the medulla of the lymph-nodes and scattered throughout the bone-marrow.

Changes in the brain seemed insufficient to account for the gross symptomatology seen during life. Occasional nerve-cells showed a minor degree of swelling, but the majority appeared normal. These changes were most marked in the basal ganglia and were almost absent from the cerebral cortex. The cerebellar cells were normal throughout. Occasional glial cells were distended with

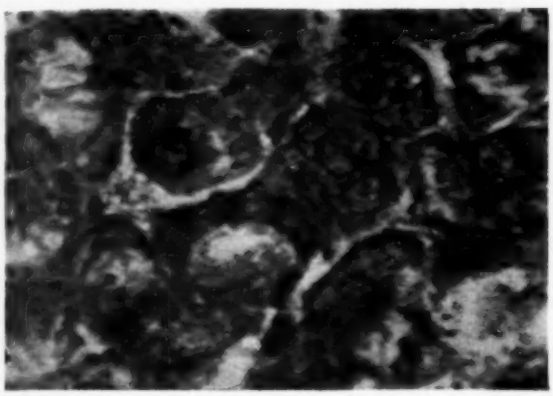

FIG. 497.—Liver, showing distension of cells with PAS-positive material (alcohol-fixed tissue, PAS stain).

clear material. As with the nerve-cells, these changes were best seen in the basal ganglia. The most striking change in the brain was the presence of large clear spaces around the blood-vessels, for the most part empty, although occasionally containing a little fibrillary material. The arachnoid was thickened and showed the characteristic connective-tissue changes described above.

The skeletal system showed a variety of changes. There was gross thickening of the periarticular tissues, the appearances of which were similar to connective tissue elsewhere. The periosteal cells were likewise grossly swollen. This was so marked that in some areas there was a superficial resemblance to cartilage. The articular cartilage showed swelling of the cytoplasm of the chondrocytes. The mottled and pitted appearance of the gross specimen was due to islands of vascular connective tissue within the substance of the cartilage (*Fig.* 495). In the bone the osteocytes tended to be similarly swollen and the matrix scanty and irregularly formed. The cortical bone was reduced in amount and the trabeculæ of the medulla were small and widely spaced. A section taken from the head of the femur (*Fig.* 496) illustrates the thinning and irregularity of the cortical bone. Sections from the epiphyses showed considerable narrowing of all zones of ossification but apart from this the appearances were normal. At the fracture site, repair appeared to be proceeding normally.

Nature of the Cytoplasmic Inclusion Substance.—The above-described histological changes were those seen in H. and E. and van Gieson stains on formalin-fixed tissues.

In attempting to identify the inclusion material a limited number of alcohol-fixed tissues were available. In view of the fact that the most pronounced storage was seen in the parenchymal cells of the liver, staining methods other than routine H. and E. and van Gieson were restricted to sections of liver unless otherwise stated.

In alcohol-fixed tissue the inclusion substance appeared granular and slightly basophilic when stained by hæmatoxylin and eosin.

Frozen sections stained for fat gave negative results.

Alcohol-fixed tissue stained by Best's carmine (for glycogen) showed considerable quantities of red-staining material, but this accounted for only a proportion of the inclusion material in the cells.

Similar tissue stained by periodic acid followed by Schiff's reagent (PAS) showed the greater part of the inclusion material to stain positively by this method (*Fig.* 497). In formalin-fixed tissue stained by PAS the amount of positively staining material was strikingly less than in alcohol-fixed specimens.

Sections of pancreas, pituitary, thyroid, lymph-node, and lung, all alcohol-fixed, were stained with PAS, and

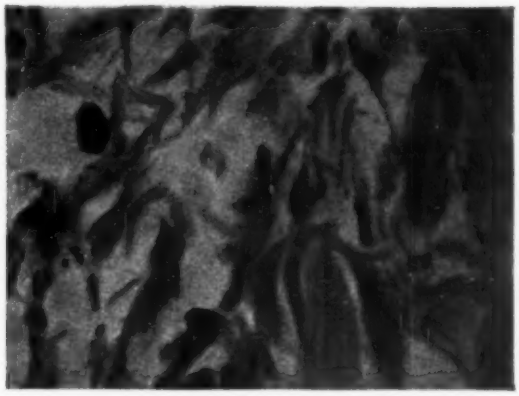

FIG. 498.—Connective tissue from the capsule of a lymph-node, showing PAS-positive material within fibrocytes (alcohol-fixed tissue, PAS stain).

positively staining material was seen in the epithelial cells of the first three organs, in the endothelial cells lining the sinuses of the lymph-nodes, and in connective tissues generally (*Fig.* 498).

There has been considerable difference of opinion in the past concerning the chemical nature of the cytoplasmic inclusion substance. Our experience tends to support that of Lindsay and others (1948) and more recently Smith and others (1952), who conclude that the substance is carbohydrate in nature. In our case it appeared that glycogen accounted for only a proportion of the stored material and that the greater part consisted of other carbohydrate material of undetermined structure. The slaty colour of the material in alcohol-fixed tissue stained by H. and E. is consistent with Lindsay's suggestion that part at least of the material may be a mucuprotein. The difference in quantity of positively staining material in alcohol-fixed sections of liver stained with Best's carmine and PAS illustrates the presence of at least two different substances of carbohydrate structure. It was noted that formalin-fixed sections of liver stained with PAS showed strikingly less positively stained material than alcohol-fixed sections, and that in the former the distribution of this material closely resembled the distribution of glycogen in alcohol-fixed tissue stained by Best's carmine.

SUMMARY

Clinical, radiological, and post-mortem findings in a case of gargoylism are presented.

A brief review of the literature and theories concerning aetiology is made.

The special staining methods support the view that there are at least two inclusion substances, probably of a carbohydrate nature, in the cells.

The cause of gargoylism remains unknown, but it would seem to be an abnormal storage phenomenon comparable with the lipoidoses and von Gierke's disease.

We are indebted to Mr. W. E. Linton, Librarian of the Otago Medical School, for help with the literature; to Miss D. Marshall and her staff for the prints and photomicrographs; to Dr. F. Bielschowsky, Dr. W. E. Griesbach, Miss E. S. Johnson, and Mr. B. MacPherson for assistance in preparing the sections; and to Miss L. North for secretarial aid.

We are also indebted to Professor Sir F. G. Bell and Professor E. F. D'Ath for criticism of this paper.

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INHALED INTRAPLEURAL FOREIGN BODY

REPORT OF A CASE

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THERE are several reported cases of inhaled foreign bodies which have progressively worked their way along the distal bronchi and through the lung substance to present as an abscess in the chest wall. Seydell (1937) has collected a series of 10 such cases where the foreign body was an ear of wheat or barley. This has the power of spontaneous progression down the bronchi due to the protruding barbs and the associated contractions of the bronchial musculature. Infrequently, the foreign body makes its way through the lung into the pleural cavity to be found at autopsy, or, as in this case, during the course of a lobectomy for bronchiectasis.

CASE REPORT

HISTORY.—L. C., aged 33, a Pole, developed a cough and pain in the right lower chest in December, 1944, while serving as an infantryman in the Polish Army. He had no knowledge of inhaling a foreign body at that time, nor was he involved in an explosion which might have resulted in a foreign body being forcibly inhaled during the blast. Cough and sputum persisted and were associated with the development of purulent sputum and recurrent attacks of pleuritic pain at the right base. On one occasion he was treated in a German Military Hospital as a case of pneumonia.

In November, 1947, he came to England and was admitted to a British Military Hospital, where the diagnosis of right middle- and lower-lobe bronchiectasis was made after a bronchogram.

He was referred to the Chest Clinic at this hospital for a possible resection in May, 1948, and put on a course of postural drainage to clear his lung fields of lipiodol and to diminish his copious sputum. On X-ray examination of his chest at that time an irregular opacity was noticed in the right lower lobe through the lipiodol shadows. However, no foreign body was detected on bronchoscopy.

His quantity of sputum increased on physiotherapy to about 5–6 oz. daily, and was very foul, with intermittent blood-staining. A course of intrabronchial penicillin was given without effect and as his general condition was good, he was discharged for physiotherapy as an out-patient.

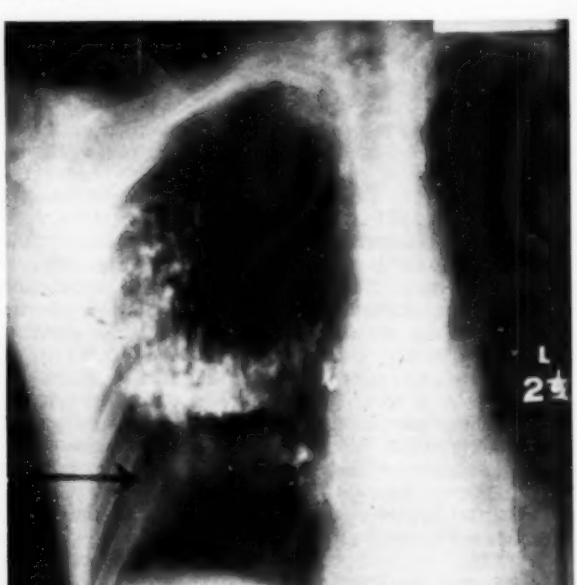

FIG. 499.—Tomogram of right lung showing undefined opacity and residual lipiodol.

On re-admission in June, 1949, there was still considerable lipiodol residue in the right lung and copious dirty sputum. Repeat bronchograms were attempted after bronchoscopic aspiration of the bronchial tree. These showed incomplete filling of the right lower

lobe and bronchiectasis of the posterior basic segments. Again, surgery was considered too hazardous on account of his persistent pus-laden sputum, which had become penicillin-insensitive. He attended regularly as an outpatient till he was re-admitted in December, 1951.

On Examination.—His general condition remained surprisingly good, with only slight finger clubbing, but no evidence of generalized osteo-arthropathy or amyloid.

Investigations.—

Blood-count (Dec. 4): W.B.C. 8900, Hb 16·75 g. per cent (113 per cent), Polymorphs 67 per cent, Lymphocytes 24 per cent, Eosinophils 3 per cent.

Sputum (Dec. 4): No A.F.B. Mixed growth neisseriæ, *Strep. viridans*, and coagulase-positive *Staph.*

Fig. 500.—Complete ear of barley recovered from right pleural cavity.

aureus. Insensitive to penicillin, but sensitive to streptomycin, aureomycin, and chloramphenicol.

Radiograph of chest (Jan. 4, 1952) showed scattered residual lipiodol still in the right lower lobe, and an opacity of indeterminate nature in the right lower zone, which did not reveal its outlines even on tomography (*Fig.* 499). *Bronchoscopy* was repeated on Jan. 22. The right stem bronchus was slightly narrowed and lined by velvety-red mucosa. The remainder of the bronchial tree was normal, but a notable feature of the bronchoscopy was the highly offensive smell of the patient's breath, not unlike that found in a putrid lung abscess. Intensive physiotherapy was continued.

At Operation.—A right thoracotomy was performed on Jan. 25 under pentothal and closed circuit G.O.E. anæsthesia, with the patient in the left lateral position. On opening the pleura the lung was found to be only lightly attached by pleural adhesions except for a localized patch of firmer mature adhesions over the anterior aspect of the outer surface of the lower lobe. In the posterior costophrenic angle a complete ear of barley was found lying free in the pleural cavity. It was black and soggy and covered with a thin, glistening, jelly-like layer (*Fig.* 500). A routine dissection lobectomy was performed, but some difficulty was experienced in closing the bronchus, which was thickened and friable from the long-continued inflammatory process.

Convalescence was complicated by a brisk episode of pneumonitis in the right upper lobe, but this cleared on chemotherapy and the patient has since been seen in the Follow-up Clinic feeling fit and free from cough and sputum.

The Specimen (*Fig.* 501).—Examination of the lobe showed the fistulous opening through which the ear had escaped from the lung. Section of the lung revealed bronchiectatic dilatation of the lower-lobe bronchi with gross thickening and dilatation of the anterior basic bronchus in which the ear had originally lodged.

COMMENT

A review of the reported cases produced very few where the foreign body presented in the pleural cavity. Davidsohn (1931) mentions a tooth which was found at autopsy in the pleura of a girl who died of bacterial endocarditis, and he mentions other reported cases in which an inhaled foreign body had passed into or through the pleural cavity. One of these was a denture with four teeth which, again, was found in the pleura at autopsy, thirteen years after being inhaled. The other cases were inhaled grass, rye, or barley, which presented as abscesses in the chest wall or as an empyema or pleural effusion.

Fig. 501.—Post-lobectomy specimen of right lower lobe showing fistulous opening through which ear of barley escaped into pleural cavity.

Seydell (1937) describes a typical case in which a head of grass had traversed the right lung and presented as an abscess in the chest wall, and he gave clinical details of 10 other similar cases he had collected. In the majority of these cases the ear of grass passed down the right bronchus and the posterior basic division to present as an abscess in the posterior axillary line of the chest. The time taken for the foreign body to declare itself as a chest wall abscess was generally two to three weeks.

A summary of available case-histories is given in *Table I*.

In the present case the course of events was atypical in some respects. The foreign body was an ear of barley and passed down the right main bronchus as one would expect, but did not pass down the posterior basic branch, which presents an almost straight line. Instead the anterior basic bronchus was traversed, as was shown by tracing back the course of the fistula on the lung surface.

It is suggested that in these cases where the ear of grass passes down the posterior basic branch, it meets the parietal pleura at a right angle, passing through it and the chest wall to present in an abscess in the posterior axillary line. A similar foreign body passing out in the line of the anterior basic bronchus

would meet the parietal pleura at an oblique angle and might account for this ear of barley being deflected into the pleural cavity.

A feature of the case which might have suggested the diagnosis of an inhaled foreign body earlier was the very unpleasant smell of decaying matter of the patient's breath at bronchoscopy.

Finally, it seems surprising that a foreign body of this size should lie dormant in the pleural cavity without giving rise to an obliterative pleurisy or empyema. This can probably be accounted for by the complete coating of mucinous material which it had acquired while in the bronchus.

Since this paper was written, we have had a child of 7 years admitted with an abscess of the right lower lobe associated with hæmoptysis, copious sputum, and gross finger clubbing. A foreign body was suspected but bronchoscopy was negative except for the putrid odour which was noticed in the case described above, and a tendency to bleed from the very inflamed mucous membrane. A complete head of grass was found in the posterior basic branch of the right lower-lobe bronchus at lobectomy.

Table I.—Available Clinical Details of Reported Cases

Case No.	Source or Author	Age	History	Inhaled Material	Method of Presentation	End-result
1	Reported by Seydell	—	2 mth.	Ear of barley	Abscess R. chest	Recovery
2	Reported by Seydell	12 yr.	3½ wk.	Ear of barley	Abscess R. chest	Recovery
3	Reported by Seydell	2 yr.	2 mth.	Ear of oats	Abscess below a. R. scapula	Recovery
4	Reported by Seydell	8 mth.	2 wk.	Ear of rye	Abscess post. ax. line R. 5th interspace	Recovery
5	Reported by Seydell	3½ yr.	2 wk.	Ear of barley	Abscess post. ax. line R. 8th interspace	Empyema drained. Recovery
6	Reported by Seydell	16 mth.	2 wk.	Ear of grass	Abscess post. ax. line R. 8th interspace	Recovery
7	Reported by Seydell	20 yr.	2 wk.	Ear of oats	Abscess below Ang. R. scapula	Died 7 mth. later P.T.B. with discharging sinus
8	Reported by Seydell	18 mth.	1 yr.	Sprig of juniper	Abscess R. chest	Recovery. Functionless R. lung
9	Reported by Seydell	8 mth.	2½ wk.	Ear of grain	Abscess post. ax. line R. 8th interspace	Recovery
10	Reported by Seydell	5 yr.	2½ wk.	Ear of foxtail grass	Abscess 5th R. interspace	?
11	Graham (1929)	8 mth.	8 dy.	Cedar branch	L. pyopneumothorax	Died
12	Schering and Shaw (1948)	4 yr.	2 wk.	Ear of foxtail grass	Abscess 6th interspace R. mid-ax. line	Recovery
13	Seydell (1937)	6 yr.	?	Ear of grass	Abscess 5th interspace R. post-ax. line	Recovery
14	Davidsohn (1931)	33 yr.	20 yr.	Tooth	L. pleural cavity. Chance finding at autopsy	Died of bacterial endocarditis
15	Reported by Davidsohn	—	2½ wk.	Piece of straw	Abscess chest wall 7th interspace	—
16	Reported by Davidsohn	—	4½ mth.	Ear of barley	Abscess chest wall 7th interspace	—
17	Reported by Davidsohn	—	6 wk.	Ear of grass	Abscess R. kidney region	—
18	Reported by Davidsohn	—	—	Ear of grass	Abscess R. lung and liver —at autopsy	Died
19	Reported by Davidsohn	22 yr.	13 yr.	4 teeth on a denture	R pleural cavity. Finding at autopsy	Died after chest illness
20	Reported by Davidsohn	—	2 mth.	Ear of grass	Abscess chest wall	—
21	Reported by Davidsohn	—	—	Ear of corn	Found in pleural cavity	—
22	Reported by Davidsohn	—	—	Ear of corn	—	—
23	Reported by Davidsohn	—	—	Ear of corn	—	—
24	Reported by Davidsohn	—	—	Ear of corn	—	—
25	Ross (1954) (present case)	33 yr.	7 yr.	Ear of barley	R. pleural cavity at lobectomy	Recovery

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DUODENAL DIVERTICULUM PERFORATING INTO ABDOMINAL AORTA CAUSING FATAL HÆMORRHAGE

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PRIMARY acquired duodenal diverticula are of relatively common occurrence, being demonstrable in 2 per cent of patients subjected to a barium meal examination of the alimentary tract (Edwards, 1948). The uncomplicated diverticula seldom give rise to symptoms, however, and a clinical diagnosis is not usually possible. Symptoms when they do occur are due to gross enlargement of the diverticulum or to associated inflammatory changes, and consist of the combined effects of obstruction and inflammation.

CLASSIFICATION

Duodenal diverticula may be classified according to their pathological aetiology into: (*a*) Primary acquired diverticula; and (*b*) Secondary diverticula caused by peptic ulceration.

The former type, which occur in the second, third, and fourth parts of the duodenum, grow out from the concave aspect of the duodenum, and may be multiple; 77 per cent occur in the second part (Edwards, 1939). An associated diverticulosis of other parts of the alimentary tract is commonly found, especially of the colon. Like other primary acquired diverticula, they are considered to be caused by a herniation of the mucous membrane through the muscular coat at sites where the latter is weakened by the passage of blood-vessels. A less likely theory, in the case of duodenal diverticula, is that of Linsmayer (1914), quoted by Odgers (1930), who concluded that aberrant growths of pancreatic tissue into the wall of the duodenum produced weak spots through which herniation of mucous membrane takes place. The diverticula seen in connexion with the termination of the bile and pancreatic ducts have received the separate descriptive term ' perivaterian ', and are due to a similar protrusion of mucous membrane through a weakness of the muscular coat where it is pierced by the ducts.

Secondary diverticula are associated with peptic ulceration and are due to ballooning of the gut wall secondary to fibrotic contraction of a healing ulcer (Edwards, 1948). The walls of the diverticula contain muscular tissue and seldom produce symptoms. They are only found in the first part of the duodenum.

COMPLICATIONS

The primary acquired diverticula, having no muscular coat, are unable to expel any of the duodenal contents which may escape into them. Symptoms may be produced by stretching of the walls by distension, or by the irritation of the putrefying contents, and these causes were stated by Spriggs and Marxer (1925) as the cause of pain, nausea, or vomiting in 15 of a series of 51 patients with proved diverticula of the second and third part of the duodenum.

Other complications may arise owing to pressure on surrounding structures, or to inflammatory changes in the diverticulum itself, or a combination of both. Such complications have been well summarized by Ogilvie (1940) as follows:—

1. Obstruction of the duodenum.
2. Obstruction of the common bile-duct and the pancreatic duct.
3. Diverticulitis: This may produce other sequelæ, viz.: (*a*) Perforation; (*b*) Duodenitis; (*c*) Cholangitis; (*d*) Calculi; (*e*) Carcinoma.

FIG. 502.—Barium meal examination showing duodenal and jejunal diverticula.

The complication of hæmorrhage is not admitted by most authors on the subject. Edwards (1948) refers to its rarity. Spriggs and Marxer (1925) include two cases of hæmorrhage in their series, but give no details.

CASE REPORT

J. A. S., aged 63, was admitted on Sept. 26, 1951, as an emergency.

HISTORY.—For the preceding month he had complained of an ache in the lumbar region. For a fortnight he had had lower abdominal pain and diarrhœa associated with epigastric pain about half an hour after meals. On the morning of admission the pain had become severe and he vomited a small quantity of bright red blood.

ON EXAMINATION.—On admission his condition was fair. Blood-pressure 160/98. Pulse-rate 100. Hæmoglobin 73 per cent. He was given a transfusion and improved immediately. He had no more vomiting, and his pain was eventually completely alleviated. His hæmoglobin on Oct. 4, 1951, was 98 per cent.

Barium Meal X-ray Examination (Oct. 7) (*Fig.* 502): A duodenal diverticulum was noted. There was no evidence of peptic ulceration in the stomach or duodenum.

Fæces for Occult Blood (Oct. 9): Faintly positive.

Gastroscopy (Oct. 9): Normal stomach and pyloric antrum except for some atrophic gastritis.

He was completely symptom-free at the time of his discharge on Oct. 12.

FIG. 503.—The aorta opened from behind with a probe indicating the duodeno-aortic fistula. Multiple jejunal diverticula and the second duodenal diverticulum are also seen.

PROGRESS.—He remained well until Nov. 17, when he was re-admitted following an attack of severe epigastric pain accompanied by copious blood-stained vomiting. On admission he was shocked. Blood-pressure 150/70, hæmoglobin 43 per cent. He improved with a transfusion of three pints of whole blood. Melæna occurred throughout the following week, but he remained free of pain, and there was no further vomiting. On Nov. 30 he collapsed suddenly, became pale and pulseless, and died within a few minutes.

AT AUTOPSY.—There were no abnormalities in the respiratory and cardiovascular systems.

Alimentary System.—The peritoneal cavity showed no gross abnormality. The gastro-intestinal tract was filled with a large amount of partly clotted blood. In the third part of the duodenum there were two diverticula, the largest of which was adherent to the aorta. In the wall of the diverticulum there was an ulcer which had eroded the aorta and caused a massive hæmorrhage into the alimentary tract. Several diverticula were present

FIG. 504.—Anterior view of the duodenum showing the mouths of both diverticula.

in the upper part of the jejunum, the largest being about 4 cm. in diameter. The remainder of the gastro-intestinal tract showed no abnormality.

The affected portions of bowel were removed (*Figs.* 503, 504) and a careful dissection made of the duodeno-aortic fistula. A representative section of a portion of the fistula (*Fig.* 505) presented the following histological features :—

Duodeno-aortic fistula : Sections show the structure of a duodenal diverticulum of considerable length which

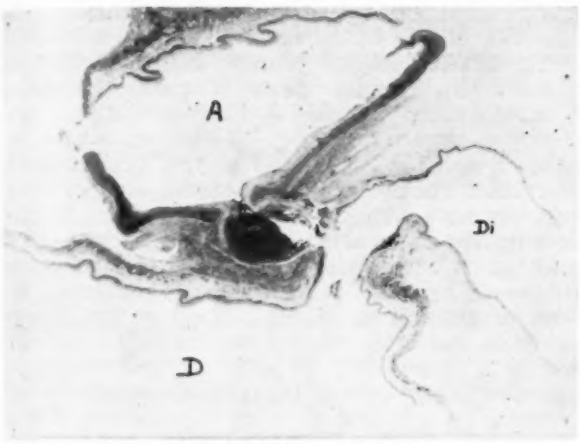

FIG. 505.—Section of duodeno-aortic fistula. **A**, Aorta ; **D**, Duodenum ; **Di**, Diverticulum. The false aneurysm connecting the neck of the diverticulum with the aorta is clearly seen, containing blood-clot. (× 1½.)

has herniated through the muscular wall of the gut. Its wall is composed mainly of fibrous tissue containing foci of chronic inflammatory cells. The lining mucosa is mostly desquamated, but here and there an odd glandular lumen is visible.

About 0·5 cm. from the origin of the diverticulum a small ulcer is present in its wall, the ulcer crater being filled with large numbers of plasma cells and considerable numbers of lymphocytes and polymorphonuclears.

The aorta shows a considerable degree of subintimal fibrosis with large numbers of cholesterol clefts in the thickened intima. In the neighbourhood of the diverticulum ulceration, the aortic wall on the one hand and the duodenum and the first part of the diverticulum on the other are welded together by a mass of fibrous tissue containing large numbers of chronic and some acute inflammatory cells.

At one point the aortic wall is interrupted and the atheromatous intimal coat turns outwards to take part in the formation of a small saccular type of aneurysm situated midway between the aorta and the duodenal diverticulum. The neck of the aneurysm and the first part of the actual sac are lined by an intimal coat ; the bulk of the aneurysm is, however, lined only by the inflamed fibrous tissue which joins together aorta and duodenum in this region.

The aneurysmal contents consist of hyalinizing laminated thrombus containing the nuclear debris of many polymorphonuclears.

It is not possible to say whether this aneurysm arose by dilatation of a localized portion of the aortic wall itself, or whether it originated in an arterial branch.

As far as the aetiology of the aneurysm is concerned, it seems reasonable to presume that the ulceration and inflammation in the diverticulum were primary factors that led to a weakening of the aortic wall and the formation of an aneurysm which ruptured into the duodenum and caused a fatal hæmorrhage.

COMMENT

A fatal hæmorrhage is a rare and, as far as we have been able to determine, previously unreported complication of duodenal diverticulum. In a recent article, Orr and Russell (1951) quote a case in association with jejunal diverticulosis and emphasize the importance of considering such an aetiological possibility in an obscure case of hæmatemesis. Presumably the same may be said of duodenal diverticulum.

The source of the hæmorrhage in this case was a matter of some discussion. On first sight it appeared that there was a direct erosion of the diverticulum into the aorta. Closer examination of the dissected specimen, however, revealed the possible existence of a short arterial trunk between the aorta and the diverticulum. Edwards refers to the existence of such a separate arterial supply, but normally such supply would arise from the inferior pancreatico-duodenal artery.

Another interesting feature of this case is the coexistence of multiple large jejunal diverticula, although if one accepts the theory that both types are due to localized, acquired, or developmental weaknesses in the bowel wall, their mutual occurrence is not so remarkable.

We wish to thank Professor R. St. Leger Brockman for permission to publish this case, and Dr. Hermitte and Dr. Azzopardi for help with the histology. The post-mortem examination and dissections were performed by Dr. Glazowski.

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IMMEDIATE PROSTATECTOMY

By MAURICE SILVERSTONE, Liverpool

When Wilson Hey, at a meeting of the Association of Surgeons, advocated immediate prostatectomy with bladder closure in patients with acute retention secondary to enlargement of the prostate, his heterodox views were not received with much favour. The publication, however, of his excellent results (Wilson Hey, 1945) coinciding as this did with improvements in anæsthesia, a greater availability of the antibiotics, and a better knowledge of parenteral therapy, encouraged many surgeons to follow his example, though without necessarily subscribing to the reasons which led him to this treatment (Stock, 1947) or even practising his technique (Bagot Walters, 1948; Hurford, 1950; Hickey, 1950). Since discussions continue to take place (Royal Society of Medicine, 1949) about when to remove the prostate, how to do so, and even who is to do so, it is thought a useful purpose might be served by putting on record a series of cases operated on by one surgeon in three hospitals offering different facilities.

Since the end of 1946 every patient with acute retention, with very few exceptions, admitted to my beds into each of three different types of hospital has had an immediate prostatectomy performed by me personally. During the period under review, that is from the end of 1946 to August, 1950, patients with non-acute prostatic symptoms, once investigation of their cardiac, respiratory, and urinary systems was complete, were also operated on if thought necessary. The degree of damage to the renal tract was never a reason for delay, if operation was considered advisable in these cases.

The hospitals to which these cases were admitted were: *Hospital I*, a teaching, former voluntary hospital, with three surgical units each having 31 male surgical beds. Our unit is staffed by a Surgeon, an Assistant Surgeon (myself), two Surgical Registrars, a House Surgeon, and a Clinical Assistant (the Lecturer in Surgery). During the relevant period a Research Assistant from the Department of Surgery was attached to the Unit and was particularly concerned with the prostatic patients. *Hospital II*, a non-teaching, former voluntary hospital. There are two surgical units, with two Surgical Registrars and a Senior House Surgeon. Each unit has 10 male surgical beds. *Hospital III*, a non-teaching, former County Council Hospital. There are two surgical units. Each has 40 male surgical beds and my unit was staffed by myself and a House Surgeon. The Medical Superintendent and the Deputy Medical Superintendent, both surgeons, were available for consultation, if necessary, by junior staff, but did not usually actively intervene in the work of the unit.

THE OPERATION

The operation that has been done is briefly as follows: The bladder having been opened and examined, any associated diverticula or papillomata are dealt with by excision or diathermy. The ureteric orifices are delineated with the diathermy needle and a Tiemann's catheter, size 11, passed retrograde down the urethra. The prostate is enucleated without the aid of a finger in the rectum in the majority of cases. In doing this, an attempt is made to enucleate the adenomata without tearing the posterior margin of the urethra, and the adenomata are dislocated into the bladder, being left attached to the trigonal margin. If this is successful, bleeding is usually much less than if the adenomata are enucleated completely. The bladder retractors are inserted and the patient put in the Trendelenburg position. The prostate, together with trigone, is then removed with diathermy, the urethra being divided proximal to the verumontanum. If the prostate is bulky, it is enucleated in parts rather than as one whole. Hæmostasis is secured with diathermy. No form of gelfoam or oxycel is used in the bladder cavity (in one case, gelfoam was used). A catheter, latterly a Dowse No. 11 with the end cut off, is threaded in the wake of the Tiemann's catheter and fastened by a Harris stitch to the abdominal wall. The bladder is closed with catgut in two layers and the abdominal wall sutured, leaving a drain down to the space of Retzius for forty-eight hours. The bladder is washed out and filled with citrate solution and the catheter plugged.

The operating time in a number of patients was about forty minutes; the majority of the cases took between one hour and one hour and a quarter. A few of the patients took over an hour and a quarter, and these were cases in which hæmostasis was difficult to procure. The anæsthesia employed was spinal in the majority of cases at Hospital I and a general anæsthetic usually in the other two hospitals.

POST-OPERATIVE CARE

Half to three-quarters of an hour after return to the ward the catheter is allowed to drain into a bottle by the bedside. At Hospital II a Duke's apparatus containing sodium citrate was fitted up so that if irrigation was necessary, a bladder syringe did not have to be brought into contact with the end of the catheter. It was found necessary to irrigate perhaps once in the twenty-four hours, and in some of the cases this had to be continued on succeeding days; 250,000 units of penicillin are given with 1 g. of sulphatriad six-hourly together with a potassium citrate mixture, and this is continued until the catheter is removed on the fifth day.

Towards the end of the series it was found that where patients had retention with overflow or where they were very old or had very thin-walled bladders, it was better for the catheter to be left in longer to minimize the risk of suprapubic leakage.

CASE DETAILS AND RESULTS

(*Table I*)

Table I shows the patients submitted to immediate prostatectomy admitted to each of the hospitals, divided into quinquennial groups. It will be noted

that the age incidence of patients in each of the hospitals does not vary greatly, but the impression exists, and it is borne out in this series, that the cases admitted to the County Council type of hospital, especially in the later age groups, were older than their years.

The table also contains a definition of the patients in each age group according to the bladder state; that is to say, whether: (*a*) admitted as cases of acute retention, (*b*) cases with prostatic symptoms who were operated on in the usual way as routine cases, or (*c*) patients with overflow incontinence.

It was decided that only patients whose bladders were up to the umbilicus and who were dribbling should be classed as chronic retention with overflow. It has been suggested (Millin, 1949) that patients with residual urine over 15 oz. with clinical, biochemical, and radiological evidence of impairment of function, and who may occasionally wet the bed at night, should be considered to be suffering from chronic retention. In the cases included in the series, however, no catheterization was permitted and, so that there should be no doubt as to the degree of retention, the level of the umbilicus was selected.

CARCINOMA
(*Table II*)

The incidence of carcinoma in the series submitted to immediate prostatectomy is shown. During the period under review the total number of patients admitted to Hospital II was 91, of whom 5 were malignant, and to Hospital III was 100, of whom 10 were malignant. A different pathologist reported on the sections in the two hospitals. Of the 238 cases dealt with in the present series, there were 18 cases of carcinoma (7·6 per cent).

Table II.—Incidence of Carcinoma

	Total	*Carcinoma*
Hospital I	47	3
Hospital II	91	5
Hospital III	100	10
	238	18

STAY IN HOSPITAL
(*Table III*)

Of the patients submitted to immediate operation, 62 were discharged within two weeks, a further 61 within three weeks, and 35 within four weeks. The remainder were detained in hospital for longer than four weeks.

It will be noted that the proportion of patients discharged within a month from the voluntary type of hospital was greater than that from the County Council hospital. This is in part due to a greater number of feeble patients in the latter group, who suffered from their general rather than their bladder state. Wilson Hey (1946) in 565 cases found an average stay of 12 days in patients with no preceding instrumentation and 23 days if this had taken place in the pre-operative period. Stewart and Taylor (1951), in their series of 1000 cases dealt with by transurethral resection, had 7·3 per cent stay longer than a month.

Table III.—Stay in Hospital

Hospital	Under 2 Weeks			2–3 Weeks			3–4 Weeks		
	A	P	O	A	P	O	A	P	O
I	2	11	—	6	11	1	1	3	2
II	11	16	1	5	18	3	5	7	1
III	12	8	1	8	9	—	7	6	3
Total	25	35	2	19	38	4	13	16	6

MORBIDITY
(*Table IV*)

1. *Suprapubic leakage* was recorded in 21 patients. It varied in degree from the mild transient case which cleared up quickly without interference, to the more severe case where it was necessary to reintroduce a catheter for several days. Occasionally reintroduction had to be repeated. Ultimately it was found that by delaying the initial removal of the catheter to beyond the fifth day in feebler patients, leakage was minimized.

Table I.—Patients submitted to Immediate Prostatectomy

Age		50–54			55–59			60–64			65–69			70–74			75–79			80–84			85–		
		A	P	O	A	P	O	A	P	O	A	P	O	A	P	O	A	P	O	A	P	O	A	P	O
Hospital I	total	—	3	—	—	2	—	2	3	—	2	12	1	6	8	1	1	4	—				1	—	1
	carcinoma										—	2	—				—	1	—						
	deaths										—	1	—	—	1	—							1	—	—
Hospital II	total	1	1	—	4	3	1	1	12	2	9	12	—	5	15	2	4	7	2	3	1	—	2	—	—
	carcinoma										—	2	—	—	1	—							1	—	—
	deaths										—	1	—				—	1	1	2	—	—	1	—	—
Hospital III	total	1	2	—	3	4	—	7	2	1	5	9	2	15	10	2	9	—	4	3	3	1	1	—	1
	carcinoma				1	—	—				—	1	—	—	3	—	—	—	1	1	—	—			
	deaths													1	1	—	3	—	2						
Total		2	6	—	7	9	1	10	17	3	16	33	3	26	33	5	14	11	6	6	4	1	4	—	2
Cases of carcinoma					1	—	—				—	5	—	—	4	—	—	1	1	1	—	—	1	—	—
Deaths											—	2	—	1	2	—	3	1	3	2	—	—	2	—	—

A, Acute retention; P, Cases of prostatic syndrome; O, Cases of overflow incontinence.
Hospital I series is part of a larger one already published (Wells, 1952).

2. *Stricture* is an unpleasant complication which was recorded in 7 cases. The site was usually the meatus or the junction of the fossa navicularis and the penile urethra. These strictures were amenable to dilatation. In one stricture in the penile urethra dilatation is still necessary every four months—two years after the operation. The causes of stricture formation are probably the weight and size of the catheter and the gumming up of pus.

Table IV.—MORBIDITY

HOSPITAL	STRICTURE	LEAKAGE	LACK OF CONTROL	EPIDIDYMO-ORCHITIS
I	2	1	1	2
II	3	8	2	2
III	2	12	1	6
Total	7	21	4	10

3. *Lack of control*: Except for the immediate period of a day or two after removal of the catheter, this was recorded in 4 patients. In all but 1 control was satisfactory at the end of three months—and in this one there was still a tendency to dribbling if the bladder was full and the patient was in a jogging conveyance.

4. *Epididymo-orchitis* occurred in 10 patients. One patient had had a bilateral vasostomy—the others, earlier in the series, had not had this done.

5. *Clot retention*: In a few cases, the bladder had to be evacuated of clot, using a bladder syringe and in one case a Bigelow evacuator. In no case in this series was it necessary to re-open the bladder. Providing there is adequate fluid intake (at least six pints in 24 hours), that the kidneys are secreting, and that watch is kept on the drainage in the first 48 hours, clot retention should not occur. If clots do form and cannot be evacuated with gentle aspiration with a bladder syringe, it is probably better to re-open the bladder rather than subject its contents and wall to excessive forcible suction. A brisk flow of urine should prevent this complication, which is of serious import if it is due to oliguria in spite of adequate fluid intake because this suggests impaired renal function due to lowering of the blood-pressure.

MORTALITY

(*Tables I, V*)

In assessing an operative procedure mortality is a primary consideration. It is sometimes forgotten that this factor is made up of two fractions, the actual death-rate and the operability of cases. No one will decry the selection of cases for treatment but, if this is done, comparisons between different series, selected by different authors, and carried out in different ways, becomes at once fallacious. In the present series an attempt was made to exclude any selection and to submit all patients to immediate prostatectomy. At Hospital I this was achieved. At Hospital II, out of a total of 91 cases, only 87 had immediate prostatectomy, the other 4 being:—

1. A patient with a bad heart and chest who had a Freyer's operation;

2. A patient admitted with congestive cardiac failure who died;

3. A patient with carcinoma of the prostate who was catheterized; and

4. A case who had a suprapubic cystostomy done about whom no details are available.

At Hospital III, 85 out of 100 patients were treated by immediate prostatectomy. A further 8 had different suprapubic operations performed with 1 death, 2 patients had carcinoma and were catheterized only, 3 had cardiac failure, 1 was admitted with inability to swallow, and 1 developed acute retention during conservative treatment of an appendix abscess.

It is also important for purpose of comparison to have a sufficient number of cases dealt with over a sufficient period of time. For example, in the present series, if recording had ceased at the end of 1949, the mortality-rate at Hospital II would have been 2 out of 67 operations, or 3 per cent. Had it been limited to the part of the 1950 figures included here, the mortality would have been 4 out of 20 operations, or 20 per cent.

Table V

Table V.—MORTALITY

	HOSPITAL I			HOSPITAL II			HOSPITAL III			TOTAL			
	T	C	D	T	C	D	T	C	D	T	C	D	
Acute retention	12	—	1	29	1	3	44	2	4	85	3	8	(9·4 per cent)
Prostatic syndrome	32	3	2	51	3	2	30	4	1	113	10	5	(4·4 per cent)
Overflow incontinence	3	—	—	7	—	1	11	1	2	21	1	3	(14·3 per cent)
Total	47	3	3	87	4	6	85	7	7	219	14	16	(7·3 per cent)

T, Total; C, Carcinoma; D, Deaths.

Table V gives the number of deaths in the individual hospitals according to the bladder state at the time of admission, and *Table I* also gives this information in five-year groups. The total number of patients submitted to immediate prostatectomy was 219, of whom 16 died, a mortality of 7·3 per cent. The total prostatic admissions to my beds during this period was 238, of whom 25 died, a mortality of 10·5 per cent.

It is interesting to note that of 107 patients under 70, 2 died, one aged 68, from pulmonary embolus, and the other, a patient of 67 with carcinoma, from recurrent ileus and urinary sepsis two-and-a-half months after operation. Of 171 patients under 75, 5 died, a mortality of 3 per cent. Jacobs (1951) reports a 3 per cent mortality in his last 100 cases under 75.

Causes of Death (*Tables VI, VII*).—The significant findings of the patients who died following

immediate prostatectomy are reproduced in *Table VI*, and in *Table VII* are the details of the other deaths, whether as a result of some other operation or not, that occurred during the period under review.

Comparable Statistics (*Table VIII*).—Having in mind the fallacies of comparing differing series, contradistinction, Wardill (1949) in 1945 had 31 deaths in 236 cases. He points out that since the average age of his cases was 71 when the expectation of life is 8 years, the expected mortality without operation is 12 per cent. The difference between these two sets of figures may be that Creevy and his associates deal

Table VI.—DEATHS FOLLOWING IMMEDIATE PROSTATECTOMY

	Patient	Age	State	Blood-pressure	Urea	Pathology	Anæsthesia	Comments
				mm.	mg. per cent			
	1 A. S.	68	P	160/100	40	B	General	Associated diverticula excised. Died from pulmonary embolus —14 days
Hospital I	2 P. W.	72	P	150/80	27	B	Spinal	Admitted with carcinoma of colon and prostatic symptoms. Died from myocardial failure and bronchopneumonia— 3 days
	3 W. J.	90	A	180/90	47	B	Spinal	I.V.P. slight hydronephrosis. Died from bronchopneumonia and left femoral thrombosis 1 month later, and 2 days after hearing of wife's death
	1 E. E.	80	A		96	B	General	Non-co-operative feeble old man. Chest and peripheral failure— 5 days later
	2 D. L.	76	O		63	B	General	Mentally unstable : died 3 weeks later from pyelonephritis
	3 A. J. M.	79	O	180/110		B	General	Gross arteriosclerosis. Mild hydronephrosis. Died peripheral failure 2 days later. B.P. dropped during operation and never rose
Hospital II	4 J. M. G.	86	A	220/120	48	B	General	Died right-sided basal pneumonia and pyelonephritis 16 days later
	5 O. R. L.	67	P		25	C	General	Dilated calices and prostatic calculi. Died 2½ months later from recurrent ileus and urinary infection
	6 H. B. S.	83	A	100/60	25	B	General	Feeble old man catheterized by housekeeper for a week. Died 9 days later from acute cardiac failure
	1 J. H. B.	74	P	225/105	30	B	General	Bed-sores : bladder sepsis. Myocardial degeneration 10 weeks later
	2 W. C. S.	79	A	210/90	45	B	Spinal	Hypostatic pneumonia and uræmia 14 days later
	3 A. L.	79	A	130/70	160	B	General	Pus in bladder and from ureteric orifices at operation : did not recover consciousness
Hospital III	4 T. B.	79	A	205/100	30	B	General	Post-operative bleeding evacuated with catheter. Collapsed and died 19 days later. Poor heart pre-operatively
	5 B. Z.	74	A	150/70	40	B	General	Bed-sores : suprapubic leak with maggot infection, incontinent. Died 10 weeks later
	6 E. H.	78	O	120/50	86	B	General	Had syphilitic aortitis. Died uræmic coma a week later
	7 H. J. F.	79	O	160/100	92	C	Spinal	Dyspnœa on admission : previously catheterized : could not swallow : developed cerebral thrombosis and died 5 weeks later

A, Acute retention ; B, Benign enlargement ; C, Carcinoma ; O, Overflow incontinence ; P, Prostatic syndrome.

Table VIII gives such a list together with the mortality-rates. The cases have not only been treated by differing operative techniques, but include immediate prostatectomies (Wilson Hey, Wells, Bagot Walters, Hurford, Hickey, Silverstone) as well as delayed prostatectomies. It will be noted that where the series is a large one, with few exceptions the mortality of supra- and retropubic methods is on the high side. It is interesting to see the very low, negligible mortality of transurethral resections in the New World (Creevy, 1951). In with cases who come to his special clinic from a wide area and hence must at least be fit to travel, whereas Wardill draws his cases from the municipal type of patient on his doorstep.

DISCUSSION

It was hoped that the analysis of a series such as this would indicate certain differences in different hospitals, but the relatively small numbers dealt with at each does not allow of dogmatic expressions of opinion. It is noted that though the age incidence

is about the same, far more patients with acute retention were admitted to the municipal type of hospital than to the others. It will also be noted that in this hospital with too few medical personnel—a Registrar was first appointed shortly before completion of the series—as well as fewer nurses, together with a heavier load of old and infirm patients needing extra nursing care, the complications were more numerous and the length of stay longer. On the other hand, the institution of immediate prostatectomy at this hospital led to the Medical Superintendent saying how much sweeter the ward was and how well and quickly the patients seemed to progress. Bladder closure is associated with increased comfort to the patient, a smoother convalescence, a shorter overall stay in hospital, and, providing there has been no previous catheterization, an absence of anxiety on the surgeon's part in good-risk cases. The smoothness of convalescence in these patients is impressive enough to underline the advisability of surgery without catheterization, that is, immediate prostatectomy in acute retention. The mortality of patients under 70 is almost negligible and even up to 75 is very low—this despite the fact that time must often be spent on securing hæmostasis. Over 75 the operation still carries an appreciable mortality, especially in acute or chronic retention.

It is interesting to note that in the cases over 75, there were 24 cases of acute retention with 5 deaths, 15 cases of prostatic syndrome with 1 death, and 9 cases with gross bladder distension and overflow incontinence with 3 deaths. If these figures were borne out in a larger series, further consideration might have to be given to the risk of immediate prostatectomy in these cases. The reduction, however, of the overall mortality as compared with the experience of many surgeons of pre-antibiotic and open delayed prostatectomy days would suggest that immediate prostatectomy with bladder closure is still the method of choice even in the poorer risk patient.

The anæsthetic is of some importance, and general anæsthesia is associated with greater blood-loss and longer operating time. On the other hand, the use of spinal anæsthesia needs the attention of an anæsthetist until the blood-pressure is stabilized—and in the non-teaching hospitals staff is not always available for this purpose. Clot retention is a danger, but was not more troublesome at Hospital III than elsewhere. This was due to insisting that nursing staff watch the drainage closely. At Hospital II, in the early years, my Registrars and House Surgeons time and again with their care and devotion saved the patients, and the 2 deaths in the first three years were in patients who would not co-operate, pulling drips down, catheters out, and so on. It was then that the impression was gained that immediate prostatectomy with bladder closure, even now that antibiotics are readily available, should only

Table VII.—OTHER DEATHS

	Patient	Age	State	Blood-pressure	Urea	Pathology	Anæsthesia	Comments
				mm.	mg. per cent			
	1 T. L.	78					—	Suprapubic only: no details available
Hospital II	2 W. McG.	72					—	Died congestive cardiac failure: no details available
	3 H. A. M.	82	A	125/70		B	General	Admitted with asthma and bronchitis. Catheterized for a month prior to Freyer, had carcinoma of roof of bladder, also excised. Developed bed-sore and died a month after operation
	1 J. M.	70	A	160/95			—	Urine full of pus. Had been catheterized outside. Died next day uræmia and myocarditis
	2 W. B.	74	A	200/95	33	B	General	Admitted with massive œdema, catheterized. Freyer 2 months later. Died 4 months after operation: no great desire to live and terminally developed peritonitis from ? perforation
	3 S. W.	70	A	144/86	120		—	Uræmia, inability to swallow. Very poor general condition. Died a week after admission
Hospital III	4 J. H.	83	A	215/110	30		—	Gross arteriosclerosis and congestive cardiac failure: had been catheterized and this continued. Died 2 weeks after admission
	5 W. R. E.	73	A	220/110			—	Myocardial failure and anginal attacks: died an hour after admission from a cardiac attack before a catheter was passed
	6 J. H. O.	73	A		92		—	Admitted with appendix abscess and developed acute retention, so catheterized. Died of uræmia 4 weeks after admission

A, Acute retention; B, Benign enlargement.

be carried out if adequate post-operative medical and nursing personnel are available. On the other hand, the figures obtained at each of the three hospitals do not altogether support this impression, and it is seen that though the complications at Hospital III were more frequent, the mortality was not significantly higher. In the 16 cases who died after immediate prostatectomy, 6 died from cardio-vascular conditions, 3 from chest complications, 1 from cerebral complications, 2 from uræmia, and in 5 there was sepsis in the urinary tract, either upper or lower. Skyrme Rees (1947), in reporting 643 prostatic cases, found urinary sepsis in 38 cases out of 88 deaths. In many of these a post-mortem had confirmed the findings.

Table VIII.—Comparable Statistics

Author	Method	Total Dealt With	Mortality		Total Admitted during Period	Mortality	
			No.	Per cent		No.	Per cent
Hey (1946)	Wilson Hey	565	24	4·3			
Wells (1952)	Wilson Hey	200	6	3·0	205		
Silverstone (present series)	Wilson Hey	219	16	7·3	238	25	10·5
Walters (1949)	Millin and some Wilson Hey	262	17	6·5	276	24	9·0
Hurford (1950)	Immediate Millin acute retention	60	4	6·7	86 (acute)		
Hickey (1950)	Millin (acute)	50	1	2·0			
Rees (1947)	Various	589	88	15	643	90	14
Riches (1949)	2 Stage	117	5	4·2			
	1 Stage	204	15	7·3			
Millin and others (1949)	Millin	757	33	4·6			
Jacobs (1951)	Millin	500	30	6	704		
Toulson and others (1951)	Millin	105	5	4·7			
Moore (1951)	Millin	116	2	1·7			
Hand and Sullivan (1951)	Millin	100	0				
Newman (1951)	Millin	103	8	7·8	106	8	7·5
Creevy (1951)	Transurethral	1000	6	0·6			
Dealt with by interns	Transurethral	560	14	2·5			
Stewart and Taylor (1951)	Transurethral	1000	19	1·9			
Wardill (1949)	Transurethral	236	31	13·0			

Comment has already been made on the difference in mortality-rates on the two sides of the Atlantic, and especially after resection. It is usually considered in this country that a long apprenticeship and much experience are necessary before one can become a successful resectionist, but Creevy (1951) quotes the results of operations done by his interns with a mortality in 560 cases of only 2·5 per cent. Stewart and Taylor (1951) in their series note that 9 per cent had to have repeat resections while still in hospital, and 8·9 per cent were admitted a second or third time for further resections.

It is interesting to note that the urine of patients suffering from prostatic symptoms is usually sterile if no instrumentation has taken place, and is infected with few exceptions when the patient is discharged from hospital. It was also noted how often in apparently decrepit patients admitted with acute retention the blood-urea was within reasonable limits, round 30 mg. per cent. In former times where the blood was first examined after two or three days of indwelling catheterization, the blood-urea was more commonly in the 50's or 60's. It would seem reasonable to deduce that the sepsis associated with catheterization somewhat impaired the renal excretion.

CONCLUSION

In the management of a case of prostatic enlargement, instrumentation, except immediately prior to operation, is associated with increased morbidity as well as increased anxiety. It is therefore advised that every such case should have an immediate prostatectomy if the patient's respiratory and cardio-vascular systems permit. This means immediate prostatectomy in patients with acute retention. In patients with overflow incontinence, some days can be spent in improving the cardio-respiratory systems, getting the patient accustomed to his surroundings, and treating his metabolic deficiencies.

If a patient with acute retention has a bad heart or chest, then catheterization can be instituted once or twice to see if the patient will himself pass urine. An indwelling catheter should be used if it is considered that sufficient improvement will occur in a few days to allow operation. With the present improvements and refinements in anæsthesia this procedure will be rarely necessary. If a patient with acute retention has a cardio-respiratory system which is so decompensated as to render operation dangerous, and which is likely to persist for more than a few days, then a suprapubic drain of the Riches type should be instituted to tide the patient over the long period necessary before prostatectomy can be carried out.

If a patient is passing urine every attempt must be made to improve his cardio-respiratory system before operation without instrumentation of the bladder.

It is a pleasure to thank Professor Wells, whose enthusiasm for the operation encouraged me to try this modification in treatment.

I must also express my indebtedness to my various House Surgeons, Registrars, and members of the Nursing Staff, without whose endeavours the mortality might have been higher.

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LATE RESECTION IN CARCINOMA OF THE LARGE BOWEL

BY DAVID A. MACFARLANE

THE natural history of cancer varies from the slowly growing atrophic scirrhous carcinoma in the elderly female breast to the rapidly anaplastic carcinoma typically seen in the very young, and it is impossible to state precisely the length of time a patient may survive harbouring a particular type of tumour. In carcinoma of the colon in particular one should not accept the diagnosis of inoperability without very blatant evidence that such inoperability exists. If at the first operation there is doubt in the surgeon's mind, it is advisable to perform a further laparotomy three or six months or even a year later. It may be that the pathological picture has changed. The following two cases are cited as an extreme example of this.

CASE REPORTS

Case 1.—A married woman, aged 53 years, was admitted to Bridgend General Hospital on Sept. 19, 1950, with acute intestinal obstruction of three days' duration, characterized by severe colicky pain, no bowel action or passage of wind, and one attack of vomiting. She had lost 4 st. in weight over the last five years. No urinary symptoms and no cough. For the last five years her bowels had been irregular, requiring occasional enemata. On further inquiry she had had a previous abdominal operation at another hospital and since then had had a ventral hernia which at the present time was painful.

ON EXAMINATION.—She was a pale thin frail little woman. Her tongue was dry and she was dehydrated. There was a large tense ventral hernia about 9 in. in diameter at its base, tapering to a blunt point, appearing through a previous right paramedian incision. This mass was tender, tympanitic, and the covering was very thin at the apex; the bowel sounds were increased on auscultation. Rectal examination was normal. Blood-count: Hb 44 per cent; R.B.C. 2,500,000; C.I. 0·88; W.B.C. 16,000 per c.mm.

TREATMENT.—Conservative treatment was carried out—gastro-intestinal suction, intravenous fluids, morphine, and enemata—with improvement. Her previous hospital notes stated that at laparotomy a mass had been found in the splenic flexure which was fixed and considered to be inoperable. There were no obvious metastases. A side-to-side ileocolostomy distal to the growth was performed to relieve distension in the transverse colon. Her ventral hernia had appeared during her post-operative course. In view of the above history and the successful reduction of her present hernia, it was decided to advise the patient that she should wear an abdominal support. This was fitted and she was discharged on Oct. 13. However, two further attacks of acute intestinal obstruction within the next three weeks indicated the need for surgery.

OPERATION (Mr. D. B. E. Foster).—An elliptical transverse incision to include excision of the umbilicus and a large area of loose skin was performed. A grossly distended appendix, cæcum, and ascending and transverse colon were found together with an ulcerating mass in the splenic flexure which, although fixed, was thought to be removable. There were no obvious metastases in the peritoneal cavity or liver. An appendicostomy was performed—the appendix being nearly 1 in. in diameter. A Mayo type of repair of the umbilical hernia was performed, using silk and catgut.

Drainage from the appendicostomy was good and colonic wash-outs were given. The general condition improved, antibiotics were given, and a radiograph of the chest showed no metastases.

On Jan. 8, 1951, an oblique incision downwards and outwards in the left hypochondrium was performed. The growth in the splenic flexure was exposed and found to be adherent to the parietes and to the left kidney, but it was freed without difficulty from the latter. A Paul-Mikulicz resection of the splenic flexure to include the tumour was performed.

The specimen was found to be a carcinomatous ulcer 2 in. in diameter on macroscopical examination. The microscopical examination report was as follows: "Adenocarcinoma of bowel. One lymph-node found in adjacent tissues shows no histological evidence of metastases".

On Feb. 12 the colostomy was closed, no attempt being made to undo the previous ileocolostomy, and the patient was discharged from hospital on March 13 wearing an abdominal support, although her ventral hernia repair was sound.

She was re-admitted in November, 1951, for closure of her appendicostomy and had gained 3½ st. in weight, had no anæmia, and her bowel habits were now regular.

Case 2.—A married woman, aged 59 years, was admitted to hospital in October, 1935, with a four months' history of bleeding per rectum; she was an old case of pulmonary tuberculosis who had had sanatorium treatment. At laparotomy carcinoma of the rectum was found, but was considered inoperable, and a left iliac colostomy was performed.

In July, 1938, she was admitted to Highgate Hospital complaining of considerable pain in the rectum. Rectal

examination revealed a large polypoidal mass which was exquisitely tender. Intrathecal alcohol injections were given, but were unsuccessful.

On Sept. 5 exploration was undertaken by Mr. N. C. Tanner under general anæsthesia, a right paramedian incision being made, and an adherent mass was felt in the pouch of Douglas. No involvement of the associated glands or of the liver was observed. Presacral neurectomy was performed and the wound closed. Perineal excision of the rectum was carried out together with excision of adherent vagina. The patient made a satisfactory recovery and was discharged on Nov. 17. The pathological report on the specimen was that it was "a tubular and papillary columnar-cell carcinoma of the rectum. There is chronic inflammation of the lymphatic glands, but no secondary growth found."

The patient was again admitted to hospital in May, 1952, with acute abdominal pain, and it was found that the blind end of the colostomy had become shut off and contained 18 oz. of pus. This was drained through the colostomy opening, and subsequently the redundant distal colon was excised. At this laparotomy no evidence of recurrent or metastatic carcinoma was found.

COMMENT

It is of prime importance to realize the variable course that carcinoma may take, and there is no reason to doubt that in these two cases, which were first operated upon by experienced surgeons, it did so. It may well be that the infective element which is present in cancer of the large bowel may be responsible for this clinical appearance of inoperability and that when it is short-circuited, as in the first case, or relieved, as in the second case, then the whole appearance changes. It is, of course, feasible that there are some surgeons who may be rather too ready to accept a diagnosis of inoperability, and a plea that this should not be done too eagerly is extended.

My thanks are due to Mr. D. B. E. Foster, Surgeon, United Cardiff Hospitals, for kind permission to publish the first case, and to Mr. Norman C. Tanner, Senior Surgeon, St. James' Hospital, London, for the notes of the second case, and for his considerable help and criticism in preparing this article.

GASTRIC MELANOMA

By PAUL STRINGER

SURGEON, MID AND WEST HERTS GROUPS OF HOSPITALS

AND CHARLES PIKE

MORBID ANATOMIST, MID AND WEST HERTS GROUPS OF HOSPITALS

MELANOMA of the gastro-intestinal tract is admittedly rare. The anorectal region and the small intestine are most often involved. Raven (1950), in an analysis of 2193 cases does not describe its occurrence in the stomach. The finding of a large melanoma of the stomach which was successfully resected is therefore of interest.

CASE REPORT

The patient, a retired Civil Servant aged 80 years, had complained of epigastric and subcostal pain for one year. The pain occurred shortly after taking food and was of a colicky nature. It varied in intensity, but there had been no periods of freedom. It never awakened him at night. There had been no vomiting, but for three weeks prior to admission there was occasional regurgitation of food at the end of a meal. This was associated with increasing constipation. His appetite, however, had remained good, and he had not lost weight.

In August, 1949, he had had an operation for removal of a tumour in the retro-orbital tissue of the left eye. It was a lobulated pigmented tumour involving the upper conjunctiva and lid margin. The bulb of the eye was not involved. The operation was followed by a course of X-ray therapy in November, 1949.

ON EXAMINATION.—In spite of his age, his general condition was good and no severe degenerative lesions were present in the cardiovascular and respiratory systems. Abdominal examination revealed a large, smooth, firm, rounded mass on the left side, extending from beneath the costal margin. It was not possible to feel its upper border. It moved freely with respiration. The liver edge was not palpable, and apart from a moderate degree of nodular enlargement of the prostate there were no other physical signs. The left eye showed a small scar at the medial end of the upper lid.

Investigations.—

Radiological:—

1. Simple radiograph of abdomen and chest—no abnormality.

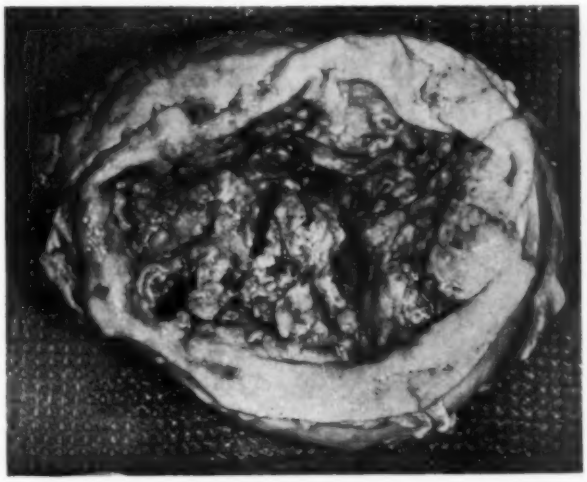

FIG. 506.—The gastric neoplasm from the internal aspect.

2. Barium meal: large carcinoma of fundus and body of stomach.

3. Barium enema: splenic flexure is displaced laterally.

4. Intravenous pyelogram: left renal pelvis is deformed by external pressure.

5. Chest radiograph—bilateral pulmonary fibrosis.

Hæmatological:—Hb 11·3 g./100 ml.; P.C.V. 37 ml./100 ml.; W.B.C.s 9000/c.mm.; Neutrophils 79 per cent, Lymphocytes 12 per cent, Monocytes 7 per cent, Basophils 1 per cent, Plasma cells 1 per cent (occasional neutrophil myelocyte). E.S.R. 30 mm. in 1 hr. (Wintrobe). Group A rhesus-positive (anti-D).

Chemical:—Spectroscopy of the fæces showed bands of hæmatin and hæmatoporphyrin. Serum acid phosphatase 2-8 units/100 ml.

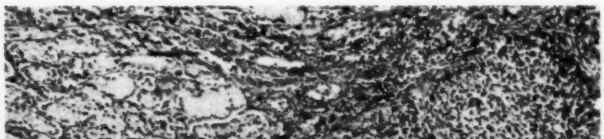

FIG. 507.—Malignant melanoma spreading mainly in gastric submucosa. H. and E. (× 60.)

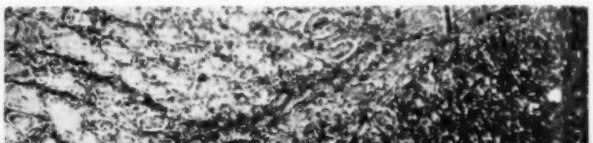

FIG. 508.—Section adjacent to that in *Fig.* 507, to show melanin. Silver method for melanin. (× 60.)

AT OPERATION.—The abdomen was opened through an upper left transrectal incision. A small quantity of free fluid was present in the peritoneal cavity. A large, firm, rounded tumour was present in the upper portion of the anterior wall of the fundus and body of the stomach. The upper limits of the tumour were within an inch of the cardia. A local excision of the mass was performed and the stomach wall closed in three layers, care being taken to maintain an adequate lumen at the cardio-œsophageal junction. No other growths were found in either large or small gut. The liver was smooth and the pelvis and retroperitoneal tissue appeared free from metastases.

PATHOLOGICAL REPORT.—The specimen (*Fig.* 506) consists of a cauldron-like mass, 11·0 cm. in diameter and 8·5 cm. high. At the mouth of the 'cauldron' there is a rim of stomach wall 1·0-2·0 cm. in width. The wall of the mass is composed of brownish tissue up to 5·5 cm. thick. On the inner surface tongues and islands of mucosa persist, covering the tumour mass. The external surface is smooth, but nodular, with greyish-brown masses showing through the serosa. In places fibres of the muscularis, stretched and thinned, are recognizable.

Histologically, the tumour is composed of spindle and polygonal cells of varying size (*Fig.* 507). The cytoplasm of many of the cells contains numerous brown pigment granules which give the staining reactions of melanin (*Fig.* 508). Mitoses are numerous and some tumour giant cells are present. The growth is spreading mainly in the submucosa and appears to be partially contained by the muscularis. In many places it is ulcerating through the mucosa. The tumour is a malignant melanoma.

COURSE.—The post-operative course was uneventful and the patient was discharged one month after admission. One month later the urine was examined and found to be negative for melanin or melanogens. Six months after operation there was no evidence of further metastases.

DISCUSSION

The occurrence of primary visceral melanoma appears improbable. The problem is discussed by Herbut and Manges (1945), who described 5 cases of melanoma of the small intestine, in 3 of which the primary tumour had been in the skin. The criteria for identification of a primary visceral melanoma have been stated by Willis (1948): "Unless meticulous search of every part of the skin and eyes and juxta-cutaneous mucous membranes proves the absence of a possible primary growth there, and inquiry elicits positive certainty that the patient has never had any skin lesion which might have been the primary source, the primary visceral origin of a melanoma cannot be accepted."

In the present case the primary tumour in the conjunctiva had been removed twenty-nine months before, and there had been no local recurrence. The interest lies in the finding of an apparently isolated visceral secondary tumour which was resectable, with relief of the patient's symptoms. No similar case has been traced, though Richman and Lipsay (1950) record a case in which secondary melanomata occurred in the terminal ileum and stomach only, and in which the ileal lesion was resected surgically.

In an extensive series of autopsies reviewed by Willis (1952) gastric metastases were present in 53. Of these, 17 were secondary melanomata. These, however, appear to be cases of wide dissemination. No mention has been found of secondary melanoma confined to the stomach.

SUMMARY

A case of melanoma of the stomach secondary to a primary conjunctival tumour is recorded. In view of the age of the patient and the doubtful nature of the tumour, local resection was preferred.

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THE PRODUCTION OF LIVER LOBE ATROPHY BY HYDATID CYSTS

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Our knowledge of biological processes is derived from two main sources: the laboratory, where studies on the experimental animal are made; and the hospital ward and pathology department, where observations are made on naturally occurring conditions during life and where these are correlated with the morbid processes revealed on physical examination or at autopsy. We must be careful not to divorce these two avenues of progress. It is important to realize that a patient can be a source of knowledge of a certain pathological condition as much as an experimental animal in which the particular lesion has been artificially produced. In fact we observe, during clinical and pathological examinations, the progress and end-results of many 'natural experiments' which it is quite impossible for even the most energetic researcher, in either the laboratory or the hospital ward, to bring about.

In discussing the contribution which pathology can make to biology, King (1950) emphasized the important role that careful observation of clinical and autopsy material plays, and the necessity for making the most of such opportunities. We must recognize that pathology is but modified physiology, and that the processes observed when abnormal agencies act on the living tissues are to be interpreted from, and will even add to our knowledge of, normal tissue responses.

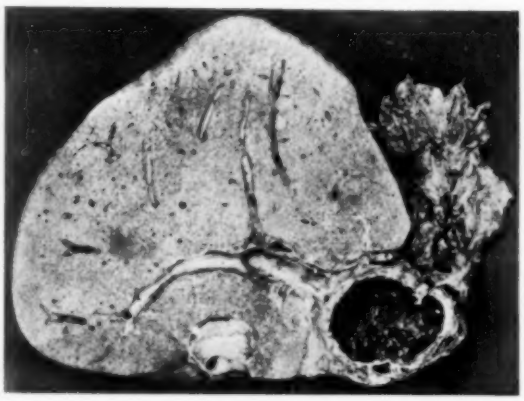

Fig. 509.—Photograph of sectioned liver, viewed from behind, showing an old thick-walled hydatid cyst occupying the site of the left lobe. The right lobe is increased in size and weighed 43 oz.

Atrophy of part of an organ results from interference with the nutritional requirements of the cells of that part. In the past many experimental physiologists have investigated the effects of interfering with blood-supply to, and bile drainage from, the liver tissue by operations on animals. As Rost (1923) has pointed out, the confusion arising from some of the early reports of these workers was probably due to individual anatomical variations in the animals used and in the precise points of ligature used. While the extension to man of the experimental ligation of such vital structures as the portal vein or hepatic artery is not practicable, there are reports of operative errors providing us with information of this nature. Finally, we are occasionally presented with those examples where there has been a long-standing and progressive interference with the nutrition of part of the liver. Such a situation arises when a hydatid cyst of the lower surface of the liver, in the region of the *porta hepatis*, by its progressive expansion, produces compression of the structures passing to one of the lobes of the liver. Owing to the long period for which this interference has been present, there has in most cases been time for compensatory hyperplasia of the remaining portion of the liver to occur so that its total mass is normal. Four such specimens are presented here, with a discussion of the mechanism by which this 'natural experiment' produces the liver lobe atrophy.

Fig. 510.—Photograph of the liver, viewed from behind, showing the large retrogressed hydatid cyst which was replacing the right lobe; there is great increase in size of the left lobe. The specimen weighed 45 oz.

AUTOPSY SPECIMENS

It is noteworthy that in each case the cyst was in no way related to the cause of death of the patient. Each cyst was thick-walled and had clearly been present for a long time.

Specimen 1.—The liver (*Fig.* 509) was from a male patient aged 70 years, who died from bilateral lobar pneumonia. The anatomical left lobe of the liver was replaced by a shrunken, pale, fluctuant mass. The mass was a retrogressed hydatid cyst and the omentum was adherent to its anterior surface. The right lobe was increased in size and the liver weighed 43 oz.

Specimen 2.—The liver (*Fig.* 510) was from a male patient aged 67 years, who died from carcinoma of the thyroid. A large retrogressed ovoid hydatid cyst with calcified walls, and measuring 4 in. by 6 in., was replacing

the right lobe of the liver. There were dense adhesions between the upper surface of this cyst and the diaphragm. The branches of the portal vein and hepatic artery, with the left hepatic duct, were all embedded in the adventitial wall of the cyst. They were deviated from their normal direct course and were stretched across the broad convexity of the lower surface of the cyst. There was a great increase in the size of the left lobe of the liver, which projected well down into the abdomen and measured 10 in. in height. The liver weighed 45 oz.

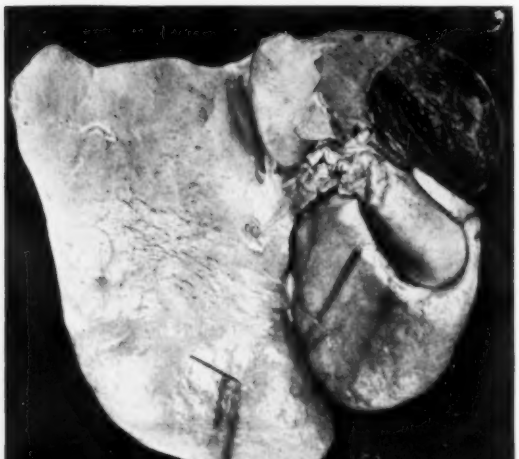

FIG. 511.—Photograph of the liver, viewed from behind, showing the hydatid cyst in the upper part of the right lobe; there is increase in the size of the left lobe and the quadrate lobe. The specimen weighed 48 oz. The higher position of the gall-bladder bed is discussed in the text.

Specimen 3.—The liver and gall-bladder (*Fig.* 511) were from a female patient aged 64 years, who died from a cerebral arterial thrombosis. A hydatid cyst measuring 3 in. by 2 in., and containing necrotic debris, was present in the right lobe of the liver. The gall-bladder was drawn posteriorly and upwards towards the cyst, and there was considerable enlargement of the lower part of the right lobe downwards in front of the gall-bladder fossa. This is interpreted as indicating that there had been atrophy of that part of the right lobe of the liver which normally lies above the level of the gall-bladder fossa and compensatory hyperplasia of the lower part. The liver weighed 48 oz.

Specimen 4.—The liver (*Fig.* 512) was from a male patient aged 53 years with syringomyelia, who died from post-operative (laminectomy) septicæmia. An old retrogressed and calcified hydatid cyst was present in the quadrate lobe, and the anterior surface of the liver showed several deep grooves radiating from this shrunken mass. The left lobe of the liver was smaller than the normal. There were two sagittal grooves on the diaphragmatic surface of the liver. The liver weighed 52 oz.

DISCUSSION

Decrease in the volume of a solid organ or, as in the present circumstance, of part of a solid organ, may be due to atrophy or to necrosis of the tissue cells. In the case of atrophy the tissue cells are still living, but, owing to nutritional supply being insufficient to maintain the cytoplasmic bulk, the volume of the cells has become less. This also follows a decrease in the functional demand upon the tissue cells, in which case the cytoplasmic bulk becomes less because the lessened energy turnover determines a diminished supply of nutriment. When the factors leading to atrophy continue to act, the tissue cells will ultimately vanish. This process of atrophy, leading ultimately to disappearance, is seen in the liver when a part is deprived of its portal blood-flow.

Necrosis of tissue cells occurs when the cytoplasmic and nuclear changes due to injury of the cell occur more rapidly and become irreversible. The most potent cause of necrosis is deprivation of oxygen. When the hepatic arterial supply to the liver is cut off, necrosis of the cells follows and contrasts with the atrophy observed after portal vein ligation. Both of these changes, however, may result in shrinkage or disappearance of part of the liver if the vessels of only that part are interfered with, and this is of importance when considering the specimens under discussion.

It is proposed to outline briefly the results of ligation of the portal vein and of the hepatic artery. While such a sudden alteration in blood-flow will have more dramatic effects upon the liver cell metabolism, the gradual change in circulation produced by a slowly growing hydatid cyst compressing these vessels will be explicable on the same basis.

Before considering some of the older experimental work on the circulation in the liver, the brilliant investigations of Wakim and Mann (1942) and Seneviratne (1949) must be mentioned. These workers, using the Knisely (1938, 1939) technique of quartz rod transillumination for observing the circulation in living structures, were able to study visually the minute circulation of the liver lobules of frogs, rats, and guinea-pigs. Their most important single contribution was the demonstration of arteriovenous anastomosis between the radicles of the portal vein and the hepatic artery. These communications were seen at three main sites, in their interlobular course, at the outer end of the sinusoids, and along the course of the sinusoids. Amphibians showed more obvious anastomosis than the mammals, but in both it was seen that occlusion of either portal vein or hepatic artery led only to a temporary reduction in blood-flow in the lobules, but if both were occluded simultaneously, complete stasis occurred.

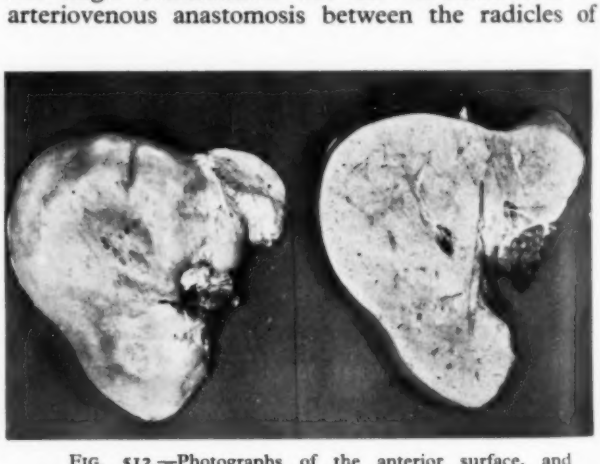

FIG. 512.—Photographs of the anterior surface, and sectioned surface of the liver, showing an old hydatid cyst in the quadrate lobe; there is gross decrease in the size of the left lobe. Weight of organ was 52 oz.

Portal Vein Occlusion.—It has been observed for many years that occlusion of the branches or even the whole trunk of the portal vein does not produce necrosis of liver cells and infarcts. This was observed in the case reports of Botkin (1864), Solowieff (1875), Borrmann (1897), Zahn (1897), Rolleston (1898), and Pick (1909). Most of these writers commented on the presence of atrophy without necrosis and Zahn's name has become linked eponymously with the " atrophic red infarcts of the liver " which he described as resembling pulmonary infarcts in appearance. The most recent record of these lesions is that of Symmers (1951).

The occurrence of atrophy of the liver cells on portal vein occlusion was investigated experimentally by Rous and Larimore (1920), who also observed that, two months after ligation of the portal supply to three-quarters of the liver, the remaining liver tissue had undergone hyperplasia sufficient to resume the original mass of the organ.

The absence of necrosis after portal vein obstruction is explicable on the basis of its terminal anastomoses with the hepatic artery. When this possibility of maintaining cell nutrition is impeded by occlusion of the interlobular venules, then portal vein obstruction will produce true infarction with necrosis of liver tissue, as was shown in those cases reported by Osler (1887) and Winternitz (1911). For the same reason, infarction followed portal vein thrombosis in the case reported by Zimmermann (1930), where there was hypoplasia of the hepatic artery which rendered the terminal anastomoses inefficient to maintain the life of the liver cells.

From these considerations it seems that the atrophy of liver cells following portal vein occlusion is functional rather than nutritional, because the hepatic artery anastomoses are sufficient to maintain the cell nutrition.

Diversion of the portal venous blood removes the functional demand on the liver cells in that part and atrophy follows. Mall (1906) has stressed the alterations in the shape of the liver during development and has shown that the main factor determining the extent and form of the parenchyma is the distribution of radicals of the portal vein ; changes in the portal tree produce alterations in the liver shape. Herringham (1905) has attributed the occasional congenital absence of the left lobe of the liver to occlusion of the long slender left branch of the portal vein, which is more exposed to transmitted pressure.

Portal vein supply to the liver is necessary for parenchymal regeneration after the experimental removal of part of the liver. Gray (1951) has shown this well in animals who have an Eck fistula. Obstruction of the portal vein above the fistula prevents regeneration, but obstruction of the vena cava above the fistula assists regeneration. He suggests that venous congestion may be a sufficient stimulus, because regeneration occurs even with portal vein occlusion if the inferior vena cava is ligated above the entry of the hepatic veins.

Finally, it may be observed that portal vein obstruction is not likely to produce atrophy in cirrhotic livers because McIndoe (1928) has shown that here the parenchyma is being supplied by the hepatic artery.

Hepatic Artery Occlusion.—Although the volume of blood supplied to the liver in unit time is only one-third of that supplied by the portal vein, the higher oxygenation of its blood renders its occlusion more catastrophic for the liver cell metabolism. Occlusion of the hepatic artery produces true infarction with necrosis of liver cells, provided that a collateral circulation, sufficient to maintain the viability of the cells, is not present.

Doyon and Dufourt (1898) emphasized that the survival of dogs after hepatic artery ligation depended on the presence of a collateral circulation. These writers and Haberer (1905) showed the importance of the right gastric artery in survival ; ligation proximal to this branch usually allowed survival because of collateral channels, but distal to this branch ligation was usually fatal.

The first recorded case of multiple areas of infarction in the liver was that of Ross and Osler (1877), and was due to thrombosis in an aneurysm at the bifurcation of the hepatic artery.

Those few examples of survival after ligation of the hepatic artery in man quoted by Smith (1920) and von Hofmeister (1922) must have been associated with the presence of collaterals. Pass (1935) agrees with Narath (1909) that survival after hepatic artery ligation in man is most likely when performed for aneurysm, because such a slowly progressive lesion may allow time for collateral channels to be established. But the usual picture is that given by Gordon-Taylor (1943), where a mortality-rate of 75 per cent followed ligation of the hepatic artery in 12 cases.

Collateral channels other than the right gastric artery are the phrenic vessels (Segall, 1923) and the fine terminal anastomoses with the portal vein. The connexions between the phrenic and hepatic arteries are small and limited to the subcapsular zone. When the interlobular anastomoses with the portal vein are inefficient, as in portal vein obstruction, ligation of the hepatic artery causes true infarction, as in the 2 cases described by Orlandi (1924). Kerr's (1933) cases, in which the right branch of the hepatic artery was ligated together with the portal vein, showed infarction confined to the right lobe of the liver.

This distribution of the infarct is important when assessing the work of Segall (1923), who demonstrated, by the injection of barium-sulphate–gelatin emulsion, that free anastomoses exist between the right and left branches of the hepatic artery in the human liver. These connexions were mainly subcapsular and near the porta hepatis, and it was shown that ligation of one main branch was followed by its filling from the other. From this work it was claimed that ligation of either main branch of the hepatic artery could be performed with impunity. However, sufficient cases have been recorded to show that, although these channels exist, the collateral flow is insufficient to maintain the life of the liver cells.

The histological changes following deprivation of the hepatic arterial supply are most apparent in the inner zones of the lobules in human beings (Bainbridge and Leathes, 1907 ; Newcomb, 1930), which are different from the involvement of all zones—the early massive necrosis of the lobules—

observed in rabbits by Cameron and Mayes (1930). The glycogen disappears early in the cellular changes and the free-fat content of the cells increases. Bainbridge and Leathes (1907) related these changes to cell anoxia because they were not seen in portal vein occlusion, and, after hepatic arterial ligation, were first seen in the inner zones of the lobules. A similar picture is seen when hepatic vein obstruction is present, as in the case of Boycott (1911), and again is referable to cell anoxia. Lund, Stewart, and Lieber (1935) summarized our knowledge by saying that " the life of the liver cells is dependent on an adequate supply of arterial blood and is affected only to a relatively slight degree by diminution in portal blood-supply ".

An important factor contributing to death after hepatic artery ligation is infection of the necrotic liver tissue by organisms from the bowel. Cameron and Mayes (1930) reported abscesses in some of their rabbits, and Markowitz, Rappaport, and Scott (1949) have shown in dogs that life is prolonged for some days by the administration of penicillin. Gray (1951) has confirmed this finding, but points out that, if there is no efficient collateral circulation, death will follow despite penicillin administration. The significance of the secondary infection is that it may have confused earlier workers in their assessment of the damage resulting from arterial deprivation.

Bile-duct Occlusion.—It is well established that bile stasis in a part of the liver, such as produced by the experimental duct ligation in animals by McMaster and Rous (1921), leads to distension of the duct system and atrophy of the liver cells in that part. An interesting example of a similar ' natural experiment ' in the human liver is the case of Carnot and Harvier (1907), where complete atrophy of a liver lobe was due to an intrahepatic biliary calculus. Two factors, suggested by McMaster and Rous (1921), contribute to the atrophy in these circumstances: the increased tension within the biliary tree, inhibiting further secretion by the liver cells and thus producing a decreased functional demand; and interference with the portal vein flow in its intrahepatic course.

CONCLUSION

The evidence which has been presented in the discussion is for the most part dealing with the effects of sudden occlusion of blood-supply or bile drainage. The mechanism by which a hydatid cyst situated in the porta hepatis or in the liver produces atrophy of large masses of liver tissue must be one of much more gradual progress. It has been shown that occlusion of a main branch of any one of the portal vein, hepatic artery, or hepatic duct will cause decrease in the bulk of that part of liver supplied. In the four specimens presented here there is no evidence of occlusion of any single structure more than another, but all have been involved in the fibrous capsule which we know as the adventitia of the slowly expanding cyst and, as far as can be ascertained by their morphology (which should here be a good guide), they have all been subjected to considerable deformation. Compensatory hyperplasia of the remaining uninvolved mass of liver tissue is the rule.

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LOCAL RECURRENCE OF CANCER IN THE LARGE BOWEL: THE ROLE OF IMPLANTATION METASTASES AND BOWEL DISINFECTION*

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INTRODUCTION

EXCELLENT five-year survival results have been obtained by sphincter-preserving operations and abdominoperineal excisions in carcinoma of the pelvic colon and rectum. During the last ten years the mortality rate has dropped and the operability rate has increased. Better understanding of the importance of pre-operative care, shock prophylaxis, modern anæsthesia, and routine bowel disinfection have enabled radical resection to be performed in patients who otherwise, in earlier days, might have been treated with only a palliative procedure. Nevertheless, in cases of rectal carcinoma, situated partially or completely below the peritoneal reflection, a difference can be seen in the five-year results between those treated with sphincter-preserving resection and those treated by excision (Miles procedure). Better results are achieved by the latter. Local recurrence in the anastomosis after resection therapy is reported by many authors (Goligher, Dukes, and Bussey, 1951; Naunton Morgan, 1951; Wangensteen, 1948). Surgeons who at first employed resection therapy, even in cases of a growth situated 5 cm. above the anorectal line, changed their technique in favour of excision, having been dissatisfied with the high incidence of local recurrence. According to Goligher, Dukes, and Bussey (1951), Gilchrist and David (1947), and Westhues (1939), distal lymphatic spread of a carcinoma in this part of the bowel is relatively rare.

In those cases of high carcinoma of the rectum with microscopically proved absence of distal lymphatic spread, the only difference between resection and excision was originally thought to lie in the fact that in the case of excision an increased amount of healthy intestine is removed, the amount of removed adjoining structures being in both procedures the same (Boerema, 1950). In view of this it is difficult to explain the relatively high incidence of local recurrence after resection therapy. Where the lesion was situated in the most distal part of the rectum, local recurrence might be explained by insufficient removal of lymph-drainage area. Greater difficulties are encountered when endeavouring to explain recurrences after a so-called radical resection in those ideal cases, without lymph-node metastases and without tumour in the lines of resection, verified by meticulous microscopical investigation.

In 1950 Boerema suggested the possibility of implantation of cancerous cells in the suture line during operation; proliferation of these cells in his opinion would be favoured by bowel disinfection.

On examining mucus from the large bowel in patients with a suspicious growth of the pelvic colon or rectum, tumour could be demonstrated in most cases of ulcerative carcinoma. These cells had more or less undergone destruction. Diagnosis was confirmed by proctoscopic examination and biopsy. Later, following operation, the distal loop of the bowel was cautiously washed out, using a solution of physiological saline. The same procedure was carried out with the resected specimen. In both solutions fresh tumour cells and even pieces of tumour were identified by microscopical control. Signs of destruction were absent or definitely reduced. The manipulations necessary to free the tumour-bearing area from the adjoining pelvic structures must have detached fresh, living tumour cells from the ulcerating surface.

In performing a resection, be it by the closed or open technique, the surgeon's knife crosses a bowel lumen contaminated with tumour cells. These cells may be implanted on the cut bowel surfaces. With needles, catgut, or silk, cells may be brought into the layers of the bowel wall. During the open technique of resection, bowel content may make contact with the adjoining serosa after releasing the bowel clamps.

It is dubious whether the cells will survive and proliferate. Pathologists state that tumour cells will not grow on intact bowel mucosa; infection of the bowel with organisms seems to be the important preventing factor. In modern times, with the routine use of bowel disinfection, conditions may be altered, favouring the survival chance of the tumour cell.

PROBLEMS

The danger of spilling tumour cells while performing bowel resection is recognized more and more (Goligher, Dukes, and Bussey, 1951; Naunton Morgan, 1951; Lahey, 1952). A new factor is the role bowel disinfection may play with regard to the survival chance of these spilled cells. Solution of the following two problems seems highly desirable:—

1. Does the possibility of implantation of tumour cells from the bowel lumen into the suture line exist in the case of resection?

2. If this be so, will the growth of these tumour cells be favoured by bowel disinfection?

EXPERIMENTS

Since it seemed almost impossible to find the answer in human pathology, the problem was approached by two series of experiments. In these experiments, rabbits, weighing 2500–4000 gr., were used. The anæsthetic agent used was nembutal, given by intravenous or intraperitoneal route. Under aseptic conditions the abdominal cavity was opened by an upper median incision; the ascending colon was delivered into the wound. The operational area was covered with wet gauze pads. A bowel segment was isolated with bowel clamps placed at 4 cm. and 14 cm. from the ileocæcal valve. Four c.c. of tumour suspension were injected into the bowel lumen. The suspension was prepared by cutting a

* Read before the Moynihan Chirurgical Club, Amsterdam, Sept. 24, 1952.

rabbit testicle, six weeks previously inoculated with the Brown and Pearce tumour, into very small pieces. This tumour, an experimental growth, found in

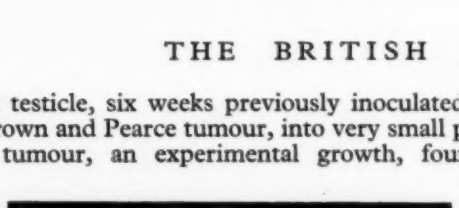

FIG. 513.—Tumour perforating the mucosal layer of the large bowel wall. Rabbit sacrificed 16 weeks after operation.

rabbits in 1921 by Brown and Pearce, has been transplanted via the rabbit testicle since that time. They regard this tumour as a malignant neoplasm

FIG. 514.—Tumour in the anastomosis. Rabbit treated with bowel disinfection (streptomycin) was sacrificed 6 weeks after operation.

of epithelial origin, composed of cells allied to those found in the bulb and root-sheath of the hair. Care was taken to prevent spilling of tumour cells via the puncture canal. The bowel was then transsected at a level 4 cm. distal to the side of the puncture; the cut edges of the bowel wall and the adjoining serosa made contact with the fluid bowel content, contaminated with fresh tumour cells. Bowel continuity was restored by making an end-to-end anastomosis. Measures were carefully taken to prevent contamination of the abdominal cavity, in the same way as is done routinely when operating upon patients in this area. The abdominal cavity was closed in three layers.

Series 1.—Twenty-three animals were operated upon in the way described. Most were sacrificed after 6–8 weeks, some succumbed in from 6 weeks to 3 months of intercurrent disease or cachexia.

Series 2.—Twenty-seven animals were treated with bowel disinfection some days before and after operation. The drugs used for disinfection were sulphasuxidine and streptomycin. Fæces were sent to the bacteriologist for culture two days prior to operation and also two days post-operatively.

During operation fæces were taken from the cut bowel for the same bacteriological investigation. In 23 cases no growth of the *Bacillus coli* was demonstrated on the day of operation; in 4 cases *coli* growth, as compared with control fæces, showed a definite reduction.

Most of the animals in this series were sacrificed 6–8 weeks after operation.

FIG. 515.—Tumour in the mesenteric corner of the anastomosis. Rabbit treated with bowel disinfection (streptomycin) was sacrificed 6 weeks after operation.

POST-MORTEM EXAMINATIONS

Series 1.—Post-mortem examination showed tumour present in 14 cases; tumour was found in 3 cases in the anastomosis and in 11 cases elsewhere

in the abdominal cavity, i.e., the serosa of the small and large bowel, the regional mesenteric lymph-glands, the dorsal and ventral peritoneum, the liver, and in the scar.

Series 2.—Tumour was identified in 15 cases in the peritoneal cavity; in 12 cases in the suture line and elsewhere, and in 3 cases only elsewhere. The localization of the tumour was the same as in the first series.

Microscopical Findings

All donor testicles were microscopically controlled for tumour. All anastomoses and specimens of tumour growth elsewhere in the abdominal cavity were microscopically investigated. In most cases tumour was seen in the subserosal layer, with occasionally infiltration of the muscular layer of the bowel wall and the submucosa. In those cases treated with bowel disinfection, tumour was identified more frequently in the deeper layers of the wall, i.e., the muscularis and submucosa. In 2 cases a typical mucosal ulcer was seen (*Fig.* 513).

DISCUSSION

From the results obtained in the first series the possibility of implantation of tumour cells from the bowel lumen into the operational area is evident. Less striking is the growth capacity of tumour cells in the suture line (3 cases).

Results in both series were identical in respect of survival chance of the tumour cell outside the bowel lumen.

With regard to the growth capacity of the tumour cell in the anastomosis a striking difference exists in the two series; in the second series, 12 out of 15 tumours were found in the anastomosis (*Figs.* 514, 515).

Since the rabbits in both series were operated upon under identical conditions, except that in Series 2 bowel disinfection was carried out pre- and post-operatively, the figures indicate that tumour growth is favoured by disinfection.

The number of cases investigated is small and the danger of applying the results achieved in experimental work to human pathology is well known; nevertheless, the possibility that local recurrence is favoured by modern surgical resection technique and the use of bowel disinfection should be kept in mind. In human surgery the advantages of bowel disinfection in lowering the mortality-rate and increasing the operability are obvious; however, it might be advisable to change the technique of resection, or to take particular measures to diminish the danger of implantation of tumour cells.

SUMMARY

Resection therapy in carcinoma of the pelvic colon and rectum is followed by local recurrence in the anastomosis in a definite number of cases. Tumour cells, identified in the bowel lumen, may be implanted during the operation from this lumen into the suture line and the adjoining structures. The effect of bowel disinfection, thought to favour proliferation of the tumour cell, is discussed. In two series of experiments these suggestions were proved to be true in rabbits.

I should like to acknowledge my gratitude to Professor Dr. I. Boerema, of the University Clinic, Amsterdam, for allowing me to carry out these investigations in his experimental laboratory, and also for his suggestions and helpful criticism.

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ATYPICAL SPREAD OF CARCINOMA OF THE COLON

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The prognosis with carcinoma of the colon is, as is well known, much more favourable than with carcinoma in most other internal viscera. This is due to the fact that for some time the growth is confined to the region of the bowel and that even later spread is usually by lymphatic embolism. Venous spread and lymphatic permeation are rarely found unless there is gross local invasion. In half the patients with a carcinoma of the colon growth has failed to metastasize by the time symptoms bring the patient for treatment. In the other half, although there are metastases at the time of operation, most of these are in the lymph-glands near the primary tumour; and thus there is a good chance of cure by surgery.

It is, therefore, disturbing to find in the perianal subcutaneous tissues what appears to be a solitary metastasis from a carcinoma of the sigmoid colon.

Whether or not retrograde lymphatic embolic spread occurs is of the utmost importance in consideration of the place of restorative resections in the treatment of carcinoma of the rectum. Dukes has shown that spread to lymph-glands more than 1 in. below the lower edge of a carcinoma of the rectum only occurs when there is blockage of the lymphatics around the growth by gross invasion; and such involvement of the lymph-glands below the primary growth is only found in one in every thousand rectums submitted to the pathologist. It may be argued that

in other cases, while there is no detectable involvement of the lymph-glands, there is nevertheless involvement of the lymphatics in the bowel wall

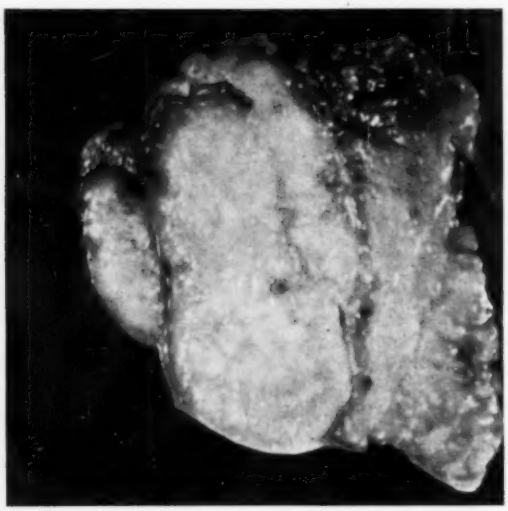

FIG. 516.—Nodule from the perianal tissues, which was apparently a solitary metastasis from a carcinoma of the sigmoid colon. (× 1·6.)

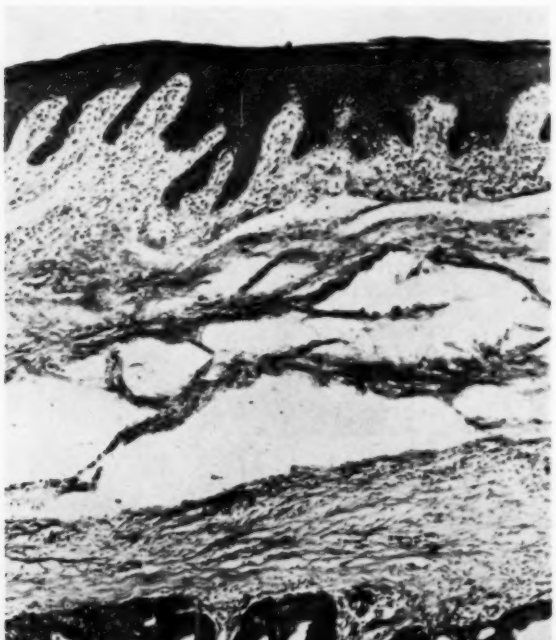

FIG. 517.—Showing the perianal skin over the most superficial portion of the metastatic nodule.

below the growth which the pathologist has failed to find. Such an argument could explain the relative frequency of local recurrences after restorative resections of the rectum, but these are more likely to be due to implantation of fragments in the cut end of the bowel during operation. However, in the case reported here there would seem little doubt that lymphatic embolism has occurred down to the perianal lymphatics. The only other possibilities are most unlikely and are, first, that the perianal tumour has arisen from some subcutaneous structure and that it has produced a microscopical appearance similar to that of the carcinoma of the colon, or, secondly, that it is the result of venous spread from the portal to the systemic circulation.

CASE REPORT

Mr. B. C., aged 82 years, was admitted to the St. George Hospital, Sydney, on Oct. 23, 1951, for excision of a nodule near the anus which had been present for at least six months. This nodule had gradually increased in size, but was not causing any other symptoms. His general condition was very good for his age, but for many years he had suffered from trigeminal neuralgia for which he had received several alcohol injections. Some eighteen months previously prostatectomy had been performed for benign prostatomegaly; and nine months previously he had been in hospital for a week because of 'gastro-enteritis'. Since this attack there had been no further alteration in bowel habit, there had been no bleeding per rectum, and there had been no deterioration in his general condition.

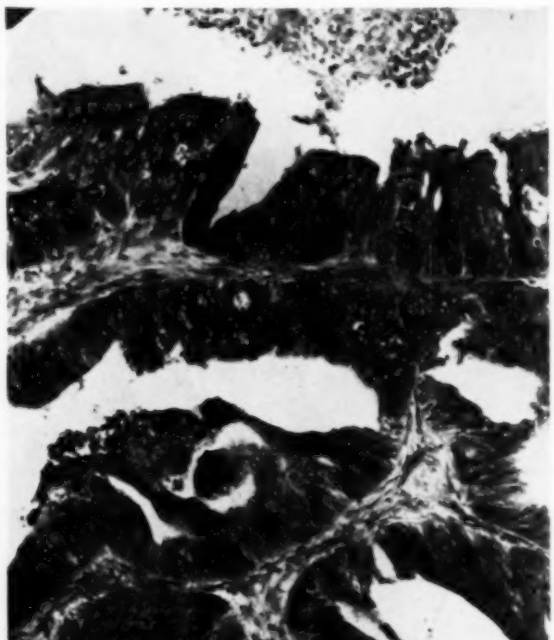

FIG. 518.—Showing the adenocarcinomatous structure of the nodule.

The perianal nodule was about 3 cm. in diameter, and was situated under the skin just to the right side of the anal orifice. The nodule was quite firm, non-tender, smooth, spherical, and moved freely under the skin and

on the deeper structures. Digital examination, proctoscopy, and sigmoidoscopy showed no other abnormality, and no abnormality was found on examination of the abdomen.

On Oct. 24 the nodule and surrounding tissues were excised under low spinal anæsthesia. The cut edge of

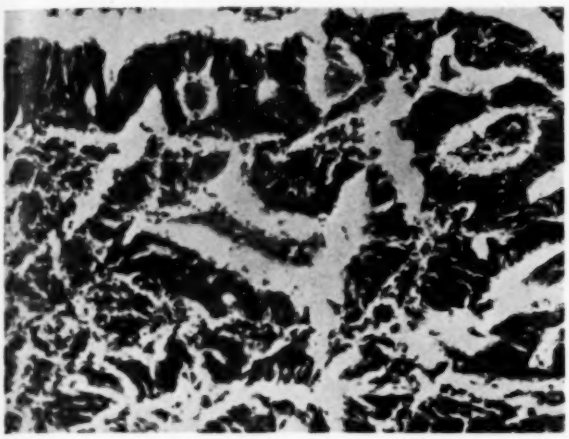

FIG. 519.—Microscopical examination of the adenocarcinoma of the sigmoid colon.

the nodule showed a variegated appearance, consisting of irregular areas in a yellowish stroma (*Fig.* 516). The edge of the nodule was clearly defined, and there was no attachment to the skin or mucosa, both of which appeared normal. Microscopical examination showed the tumour to be an adenocarcinoma (*Figs.* 517, 518). No involvement of the lymphatics could be found in the sections.

The report on a barium examination of Oct. 29, was that "the enema ran from the rectum to the cæcum and into the terminal ileum. In the sigmoid colon there is a constant irregular constrictive lesion about 2 in. in length and this is almost certainly due to a carcinoma".

After preparation with phthalyl sulphathiazole and streptomycin given orally a carcinoma of the sigmoid colon was resected and an end-to-end anastomosis performed on Nov. 5. At the time of this operation there was no sign of any intra-abdominal metastasis. Following operation convalescence was uneventful.

The resected portion of the colon was 8 in. long and showed a carcinomatous ulcer 2 in. from one end and almost encircling the lumen. Spread through the muscle coat had occurred with slight involvement of the extra-colonic tissues, but there were only six small, soft lymph-glands to be found in the mesentery. Sections of the tumour of the bowel (*Fig.* 519) confirmed the diagnosis of adenocarcinoma, and its microscopical structure resembled that of the perianal nodule. No malignant involvement of the lymph-glands or lymphatics was found in the specimen.

Since the operation he has remained in good health and no other metastasis has been detected.

SUMMARY

A case of adenocarcinoma of the sigmoid colon is reported in which the only metastasis found was in the perianal subcutaneous tissue about 18 in. below the primary growth.

My thanks are due to Dr. A. E. Gatenby for the pathological examinations, and to Dr. C. Badham for the radiological examination.

THE CONSERVATIVE SURGICAL TREATMENT OF MIXED TUMOURS OF THE PAROTID

BY R. HUNTER

REGISTRAR, THE MIDDLESEX HOSPITAL; LATE ASSISTANT TO THE DIRECTOR OF SURGICAL STUDIES, ADELAIDE

OF recent years there has been increasing interest in the radical surgery of the parotid salivary gland (Bailey, 1941, 1948; Redon, 1945; Kidd, 1950; Audouin, 1950; Brown, McDowell, and Fryer, 1950; McCune, 1951; Eddey, 1951; Shucksmith, Boyle, and Walls, 1951). This interest has been stimulated by the bad results of the treatment of malignant disease of the parotid, and by the alleged frequency of recurrence of mixed tumours following conservative surgery. It would seem that for malignant disease of the parotid a total removal of the gland with sacrifice of the facial nerve is usually indicated. Various radical operations have been performed for mixed tumours, including total and subtotal parotidectomy with preservation of the facial nerve.

Before recommending such radical procedures for mixed tumours, two points must be established; first, that conservative surgical treatment is unsatisfactory because of the high recurrence rate; and, secondly, that radical surgery is not followed by any significant number of facial nerve injuries. It is hoped to show in this paper that the first of these points has not been proven. As for the second, it is probably too early yet to assess the position accurately, but in those series which have been published facial nerve lesions do occur. Kidd (1950) had one incomplete lesion in 9 cases. In a series of 27 cases McCune (1951) reports a significant degree of permanent facial palsy in 5 cases, in 2 of which, being recurrent cases, the nerve or a main division was deliberately sacrificed because of scar tissue. The results of the French surgeon, Audouin (1950), are much better. In 25 cases he had only 3 with very mild facial paresis.

Several procedures may be grouped under conservative surgical treatment—namely, simple enucleation, excision plus a narrow margin of gland, and enucleation followed by post-operative irradiation. Simple enucleation of the tumour is definitely followed by a high recurrence rate, being 25 per cent in one series of 400 cases (McFarland, 1943). The second method lowers the recurrence rate to 13 per cent, according to Stein and Geschickter (1934). The best results of conservative surgery have followed enucleation and post-operative irradiation.

Ahlbom (1935) reported a recurrence rate of 2½ per cent in 40 cases followed for over five years. Patey (1940) observed 24 cases for periods varying from two years to twelve years, and had recurrences in 2 of these.

The cases presented below were treated at the Royal Adelaide Hospital between the years 1930 and 1951, and represent a continuous unselected series. We are only concerned here with the follow-up of cases of mixed tumour treated by enucleation and post-operative radiotherapy, but an analysis of all cases of parotid tumours is presented to place these in their correct perspective. The total of 76 tumours was made up as follows :—

Mixed tumour	51	Adenolymphoma	5
Adenoma	1	Malignant tumour	9
Cyst	2	Unclassified	8

The diagnosis of the 8 unclassified tumours was not confirmed by pathological section, and so they have been omitted from the discussion. Of the 51 mixed tumours, 9 were not traced. The remaining 42 cases were treated as follows :—

Radiotherapy alone	4 cases
Enucleation	11 cases
Enucleation and radiotherapy	30 (including 3 recurrences from group 2 above)

The 30 cases in which we are interested were followed for periods up to seventeen years, the distribution being shown below :—

Years	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Cases	1	5	1	3	1	3	4	2	2	3	1	—	—	1	—	2	—	1

In this series treated by enucleation and post-operative radiotherapy there has been no case with a local or glandular recurrence. One case had unproven distant recurrences; the patient, aged 70, had a tumour the size of a pea treated as above. After four years, with no local recurrence, radiographs of the ribs and cervical spine showed changes suggestive of possible metastases. The patient died one year later from congestive cardiac failure without this possibility being confirmed. Thus in 30 cases there has been but 1 doubtful recurrence.

DISCUSSION

Such a series of a comparatively uncommon condition receiving one particular type of treatment is necessarily small. Considered in conjunction with other similar series (Ahlbom, 1935; Patey, 1940) the results take on some significance. Thus, in a total of 94 cases there have been at the most only 4 recurrences, which compares very favourably with a recurrence rate of 7·4 per cent following radical surgery (McCune, 1951).

Of necessity there are dangers associated with the long and difficult operation of total parotidectomy, and therefore it is considered that conservative surgery must still hold a very important place in the treatment of mixed parotid tumours.

SUMMARY

1. A series of 30 cases of mixed tumour of the parotid treated by enucleation and post-operative radiotherapy is presented.

2. The literature on the surgical treatment of this condition is reviewed.

3. It is concluded that enucleation and post-operative radiotherapy is a satisfactory form of treatment with a low recurrence rate.

My thanks are due to the Medical Superintendent, Royal Adelaide Hospital, for permission to examine the records of the hospital; and to Dr. J. C. Mayo for making available the follow-up records of the Radiotherapy Department.

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SHORT NOTES OF RARE OR OBSCURE CASES

A CASE OF CAROTID BODY TUMOUR

By E. N. MacDERMOTT, Galway

Even isolated cases of carotid body tumour are of sufficient interest and rarity to justify reporting, but when considered in association with the problem of maintaining adequate cerebral circulation after resection of the carotid bifurcation they assume a much greater importance.

It is a matter of common knowledge that straightforward resection of the carotid bifurcation carries with it a risk of severe, even fatal, cerebral damage—the mortality is estimated at 30 per cent (Monro, 1950; Corbett and McClintock, 1950; Charache, 1949; Gordon-Taylor, 1940; and others).

Insasmuch as this is a desirable step in some cases of carotid tumour as well as in other cases, e.g., malignant gland dissection, aneurysm, wounds, etc., many techniques have been advised to increase its safety:—

1. Preliminary compression or, even better, ligation of the common carotid. Dandy (1942) states that this reduced his mortality for internal carotid ligation to 4·5 per cent.

2. Replacement of the resected vessel by a graft of autogenous vein (Monro, 1950) or, in view of recent work (Rehn, 1952; and others), by a graft of homogenous artery.

3. Suture of common to internal carotid has been done (Enderlen, 1938).

4. Suture of external to internal carotid. Arnulf (1950) says this was first suggested by Quenu (1907) and Morestin (1907) and actually performed by Lefèvre in 1918 and by Petit-Dutaillis (1929). Conly and Pack (1952) advise this step, which they have actually used in five published cases of gland resections. They seem to have been unaware of the work of these French surgeons. It is interesting, therefore, that Marquis and Lefèvre (1920) now have doubt about the efficacy of external to internal carotid circulation.

In view of the risk, many authors, e.g., LeCompte (1948) and Lahey and Warren (1951), advise that excision of carotid body tumours, necessitating ligation or resection of the internal carotid, should only be done when there is definite evidence of malignancy. Some writers, e.g., LeCompte (1948) and Willis (1948) almost deny that these tumours can be malignant but malignancy is usually estimated as about 15 per cent—a figure equal to the difference in mortality between resection alone—15 per cent—and resection with carotid ligation—30 per cent (Goldberg, 1947).

In the case now reported, no untoward symptoms developed after resection of the tumour and the carotid bifurcation *en bloc*. Probably the infiltration of the cervical sympathetic with 2 per cent novocain may have contributed to this result, especially in view of the striking improvement in cerebral circulation following infiltration of the stellate ganglion or its resection demonstrated by de Sousa Pereira (1952) in cases of internal carotid obliteration.

It is not proposed to discuss details of pathology, for which the reader is referred to the excellent papers of LeCompte (1948), Monro (1950), and Lahey and Warren (1951).

Tumours, similar morphologically, may be met with anywhere where 'glomus' tissue can occur, i.e., between the petrous bone and aortic arch. The classical carotid body tumour occurs in the carotid bifurcation, grows slowly, and produces no symptoms except those due to pressure on adjacent structures. They may cause occasional attacks of giddiness and weakness; occasionally fainting (as in one unoperated case known to the author). The tumour is smooth, firm, often fluctuant, sometimes pulsatile, movable laterally but not along the neck, and, typically, the external carotid artery can be felt pulsating as it crosses in front of the tumour. The size varies widely up to the enormous tumour described by Brown and Fryer (1952) which measured 10 × 15 × 12 cm.

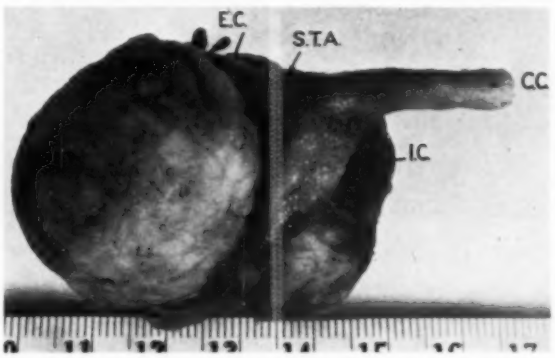

Fig. 520.—Carotid bifurcation and excised tumour. Note narrowing of upper portion of internal carotid due to pressure of tumour. This was probably an important factor in the smooth post-operative course of the patient. C.C., common carotid; E.C., External carotid; I.C., Internal carotid; S T.A., Superior thyroid artery.

CASE REPORT

History.—Mrs. M. C., aged 55, was first seen on Aug. 15, 1951, complaining of a tumour the size of an orange in the right carotid triangle which had been present for eight years but recently had begun to increase in size so as to alarm the patient and her daughter. The tumour was painless, but during the previous six months the patient had had several attacks of giddiness and weakness though she had never fallen or lost consciousness. Her vision used to fail in the attacks, but no relationship to posture was ascertained.

On Examination.—There was a smooth firm lobulated tumour at the level of the carotid bifurcation presenting in front of the right sternomastoid behind the

angle of the jaw. The mass was movable laterally but not longitudinally and was apparently not infiltrating surrounding structures. There was no tenderness, and no lymph-gland enlargement was present either in the neck or elsewhere, nor was the spleen palpable: the external carotid artery could not be felt in front of the tumour. On general examination, apart from slight arteriosclerosis and very infected teeth, there was no other abnormality. The septic teeth were extracted and when

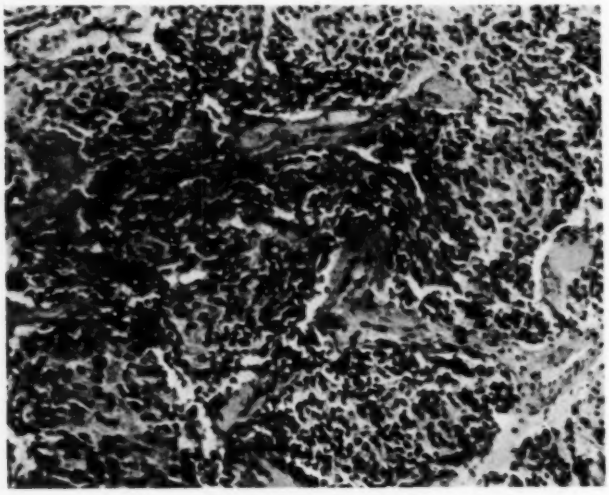

FIG. 521.—Section of carotid body tumour shown in preceding figure. (× 100.)

she returned on Sept. 13 she thought the mass had diminished, but was very worried about the possibility of malignancy and readily agreed to a biopsy or further operation if local conditions demanded it.

Diagnosis pre-operatively inclined to a chronic lymph-adenitis, possibly tuberculous, or a neoplasm of a lymph-gland. A carotid body tumour was not considered likely, though included as a possibility.

AT OPERATION (Sept. 15).—Under gas-oxygen-ether anæsthesia an incision was made over the tumour parallel and anterior to the anterior border of the sternomastoid. The tumour was found to be more extensive than expected and was pressing on the common carotid artery, which was constricted appreciably; the growth was gripped in the angle of the bifurcation and had a dumb-bell shape, the external and internal carotids being partly buried in the mass which overlapped and constricted them. No obvious line of cleavage could be found and the tumour appeared to be infiltrating the vessels. Resection, including the bifurcation, was decided upon, but anastomosis between external and internal carotid was impossible on account of the shortness of the stumps. Immediately after ligation of the common carotid the stellate ganglion and cervical sympathetic chain were infiltrated with 30 c.c. of 2 per cent novocain. The hypoglossal and ansahypoglossi nerves, which were in close contact with the tumour, were preserved intact.

PROGRESS.—The patient developed slight difficulty in phonation and swallowing which was ascribed to operative trauma. There was at no time any symptom suggestive of cerebral damage. During the operation one pint of dextran with one pint of plasma were given, and later two pints of plasma. Convalescence was uneventful except for a slight localized superficial infection; this subsided rapidly with penicillin. The patient was discharged after fourteen days. Swallowing was then almost normal, but she was still slightly hoarse.

THE SPECIMEN.—The tumour measured 5 × 3 cm. and weighed 50 g. (*Fig.* 520). The position at the bifurcation of the common carotid artery caused it to be deeply grooved by the internal and external branches. 2 cm. of the internal carotid and 3 cm. of the external had been resected with the tumour. The carotids were attached to the tumour by layers of their fibrous tissue but the neoplastic tissue was not adherent to the wall of the vessels. The tumour itself was surrounded by a thin translucent fibrous capsule. On section the cut surface was firm and of a greyish colour mottled by reddish areas (*Fig.* 521).

The tumour consisted mainly of whorls or clusters of epithelioid type cells surrounded by a supporting stroma which was very rich in capillaries. There was an angioma-like arrangement of the blood-vessels, in some places being almost cavernous. Other areas had an alveolar arrangement or were almost glandular in appearance. A portion of the tumour, fixed in Zenker's solution, did not give the chromaffin reaction.

Two months after operation the patient was in good condition but still had slight evidence of hypoglossal damage shown by minor dysphagia and slight protrusion of the tongue to the right.

I am indebted to Dr. J. Kennedy for the photographs and pathological report and to my former House Surgeon, Dr. M. Shea, for his careful notes and care of the patient.

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AN UNUSUAL CASE OF CARCINOMA OF THE HEAD OF THE PANCREAS

By E. M. NANSON

FROM THE DEPARTMENT OF SURGERY, BRISTOL UNIVERSITY

In 1951 Loggan and Kleinsasser made a very comprehensive review of the surgery of the pancreas. They collected 123 cases in which a radical pancreaticoduodenal resection had been performed for carcinoma of either the duodenum, ampulla of Vater, or head of the pancreas. Therefore this ground will not be covered again in this communication; but a case of carcinoma of the head of the pancreas will be recorded which presents none of the usual features of the disease.

The special points of interest in this case are:—

1. The age of the patient—17 years.
2. The absence of any obstruction of the common bile-duct or of the pancreatic duct; therefore the absence of jaundice.
3. That the presenting symptom was intestinal hæmorrhage producing profound anæmia.
4. That the carcinoma of the head of the pancreas had produced a punched-out ulcer of the second part of the duodenum from which the hæmorrhage had occurred.

CASE REPORT

History.—The patient was a single girl, aged 17 years, who was working in the Women's Royal Air Force. She had been perfectly well up to the onset of her illness

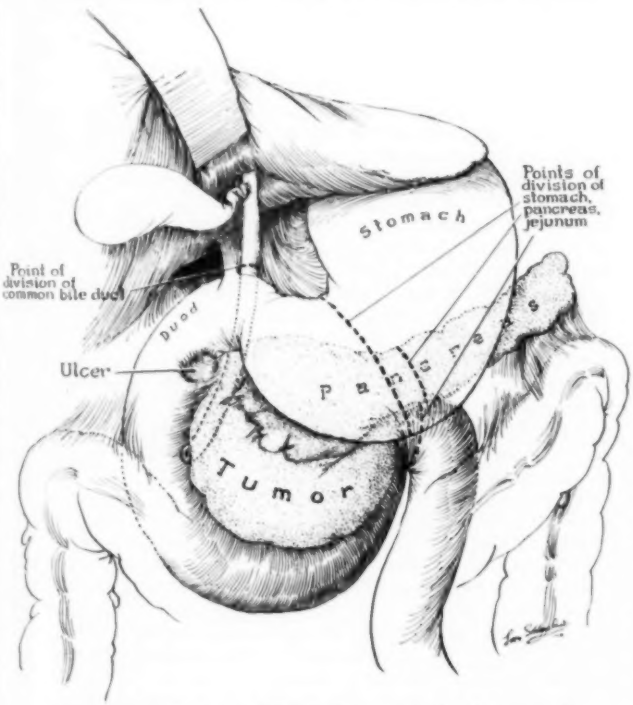

Fig. 522.—Tumour of head of pancreas showing normal size of common bile-duct and limits of excision.

8 months before her admission to the Bristol Royal Infirmary on Aug. 15, 1951, under Dr. A. M. G. Campbell. In January, 1951, she suddenly developed breathlessness and palpitations over a period of 3 days, and had a melæna stool. Her hæmoglobin dropped to 35 per cent at this time, but it improved rapidly with treatment.

On July 10 she was admitted to the Yeovil Hospital because of the sudden recurrence of breathlessness and palpitation, associated with melæna. Her hæmoglobin was 60 per cent and the benzedine reaction on her stool

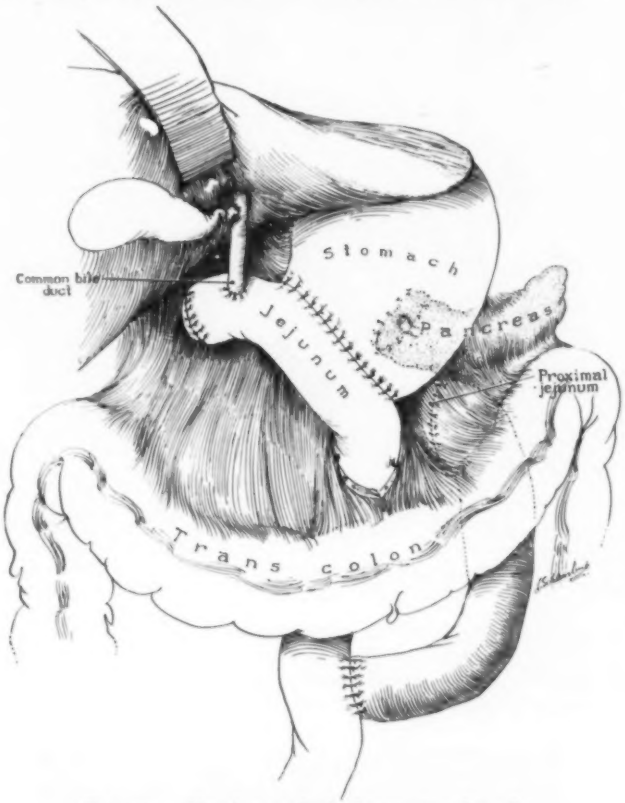

Fig. 523.—Showing method of reconstruction of gastro-intestinal tract.

was strongly positive on three separate occasions. A barium meal was reported to be normal on this occasion. The barium enema was also normal.

She was admitted to the Bristol Royal Infirmary for the purpose of further investigation on Aug. 15. She was symptom-free, and at no time had she had any abdominal pain or discomfort. Her hæmoglobin was 93 per cent and the red blood-cell count was 4·9 million per c.mm. Three consecutive stool examinations were negative for occult blood. The barium meal was repeated on Sept. 3 by Dr. R. H. Owen. It revealed no demonstrable abnormality in the œsophagus, stomach, duodenum, or small bowel. A fractional test-meal on Sept. 2 was also normal. She was discharged with no diagnosis made, but ulceration in a Meckel's diverticulum was considered the most likely.

She was re-admitted to the Bristol Royal Infirmary on Aug. 19, 1952, having been well up to one week prior to admission. She then again developed lassitude, breathlessness, and pallor. Her hæmoglobin was found to be 50 per cent by her general practitioner and on the day of admission it was 35 per cent. The B.S.R. was 24 mm./1 hour and the appearance of the blood-film was

that of an iron-deficiency anæmia secondary to hæmorrhage. Two days after admission she had a melæna stool. On clinical examination no abnormality was found other than pallor. She responded well to the

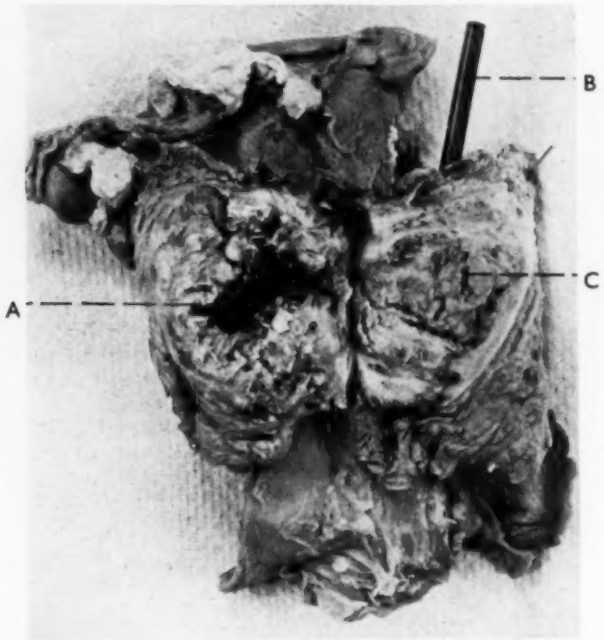

FIG. 524.—Gross specimen of carcinoma of head of pancreas. The tumour has been bisected and turned back. A black rod has been passed from tumour through ulcer into duodenum. A light-coloured probe has been passed into the common bile-duct. A, Black rod passing through ulcer into duodenum; B, Probe in common bile-duct; C, Cut surface of tumour well encapsulated. (*Approximately half scale.*)

oral administration of iron and by Aug. 25 her hæmoglobin was back to 72 per cent. The author was then asked to see her and advised laparotomy with the expectation of finding a Meckel's diverticulum.

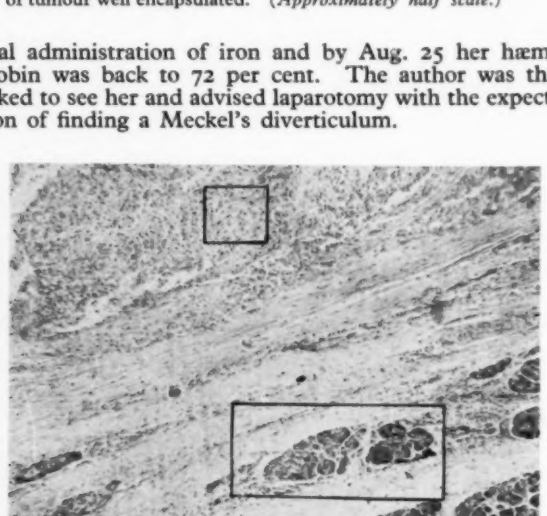

FIG. 526.—Section of tumour edge showing normal pancreas capsule, and tumour, with tumour-cell collections infiltrating capsule (lower inset). (× 45·5.)

An interesting point in her family history was that her father, aged 52 years, had a cerebral tumour explored three years previously and the histology confirmed by biopsy. This was treated by deep X rays with complete relief of symptoms.

THE OPERATION.—On Aug. 28 a laparotomy was performed by the author, through a mid right paramedian incision. A smooth mobile rounded swelling about the size of a tennis ball was found in the head of the

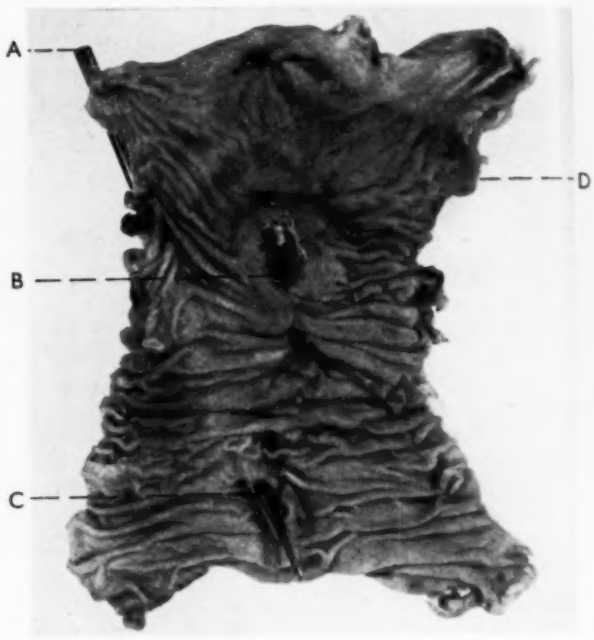

FIG. 525.—Gross appearance of portion of duodenum excised. The lumen has been laid open, and a probe has been inserted in the common bile-duct. The ulcer was 1 cm. in diameter. A, Probe in common bile-duct; B, Tumour ulcerating into duodenum; C, Ampulla of Vater; D, Pylorus.

pancreas. The common bile-duct was not obstructed, nor was the pancreatic duct of Wirsung (*Fig.* 522). There were no obvious metastases in the liver or the adjacent lymph-nodes. The tumour felt semicystic but aspiration failed to find any fluid. There was a round punched-out ulcer 1 cm. in diameter on the medial wall of the second part of the duodenum 5 cm. above the ampulla of Vater (*Figs.* 522, 525). This ulcer communicated with the tumour mass and was the obvious source of the bleeding. The remainder of the abdominal and retroperitoneal organs were normal. The duodenum was opened, the ulcer inspected, and a finger passed through it into the tumour. A radical pancreaticoduodenal resection was then performed. Continuity was restored by dividing the jejunum across at the apex of its second loop, and making a Roux-en-Y loop. The end of the Roux loop was closed and this was passed up through the transverse mesocolon. The common bile-duct was then implanted into the antimesenteric border of the Roux loop, using interrupted thread sutures in a single layer. The stump of the pancreas was implanted into the posterior wall of the stomach as recommended by Wells, Shepherd, and Gibbon (1952) and Dill-Russell (1952). The stomach was anastomosed to the Roux loop distal to the common bile- duct. The stump of the fourth part of the duodenum was closed (*Fig.* 523). Four pints of blood were given in the course of the operation.

PROGRESS.—The patient made a smooth recovery without any leakage from the various anastomoses, until the twelfth post-operative day, when she developed signs of sudden intestinal obstruction. The abdomen was re-opened and the Roux loop was found to be kinked and obstructed where it passed through the transverse mesocolon. This was freed up, and following this,

convalescence was remarkably smooth. Her appetite has been good, and her bowel motions normal. Dr. G. K. McGowan kindly carried out an estimation of the trypsin in her gastric juice and also on her stools and found it to be present in small quantities, and an estimation of her fat absorption showed that 95 per cent was being absorbed, so that it can be assumed that the pancreatic stump is secreting into the stomach.

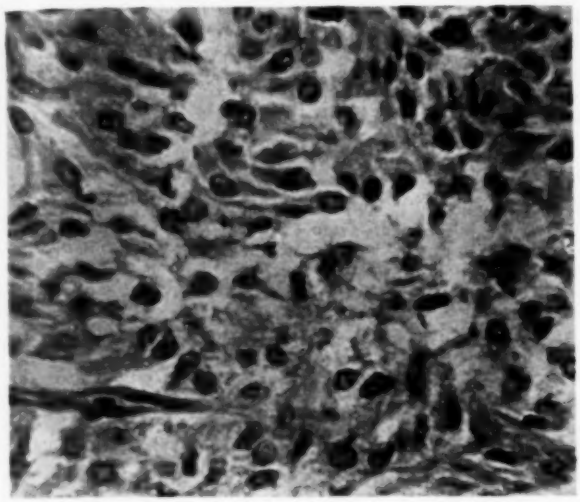

FIG. 527.—Higher powered view of top inset in *Fig.* 526, showing tumour cells. (× 420.)

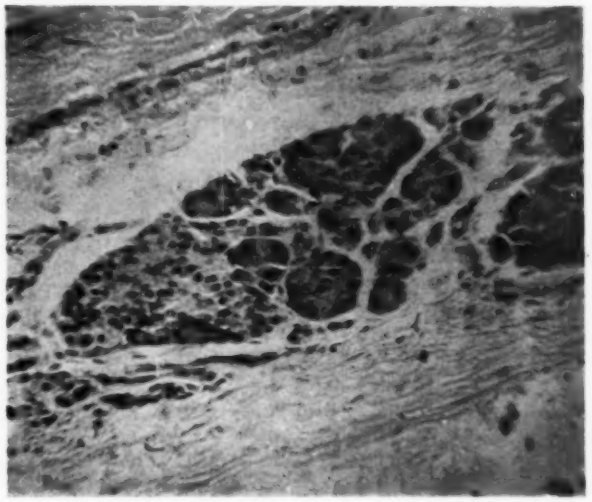

FIG. 528.—Higher powered view of lower inset in *Fig.* 526, showing undifferentiated tumour cells merging into acini formation invading capsule. (× 195.)

THE SPECIMEN.—Dr. Oliver Lloyd reported that the head of the pancreas was occupied by a well-encapsulated rounded solid tumour 5 cm. in diameter (*Fig.* 524). Some normal pancreatic tissue appeared to be stretched over it. The common bile-duct was not dilated nor was the pancreatic duct. There was a round punched-out ulcer of the second part of the duodenum, 1 cm. in diameter, connecting the centre of the tumour with the lumen of the duodenum. This ulcer was 4 cm. above the ampulla of Vater (*Fig.* 525). There were no obviously involved adjacent lymph-nodes.

Microscopical sections of the tumour showed it to be of glandular origin. Its cells were round and rather small. They had small neat central nuclei. They were arranged in a distinctly perivascular pattern, with a tendency to tubular formation in other parts. The tumour was invading its capsule (*Figs.* 526–528); mitoses were rare. The diagnosis was that of adenocarcinoma of low-grade malignancy possibly arising in the duct of Santorini.

DISCUSSION

Mielcarek (1935) reviewed the authenticated cases of carcinoma of the pancreas in people under 20 years of age. He found only 5 and added 1 case of his own. The details of these 6 cases are as follows :—

1. Female, aged 7 months. Carcinoma of head of pancreas. Metastases in liver and lymph-nodes.
2. Female, aged 2 years. Carcinoma of head of pancreas. Metastases in liver, lungs, and lymph-nodes.
3. Male, aged 4 years. Carcinoma of head of pancreas. Metastases in liver and lymph-nodes.
4. Male, aged 13 years. Carcinoma of head of pancreas infiltrating duodenum. Metastases in liver, kidneys, and lymph-nodes.
5. Male, aged 15 years. Carcinoma of head of pancreas 7 cm. in diameter, producing biliary and pancreatic obstruction.
6. Female, aged 19 years. Carcinoma of tail of pancreas, with metastases in liver and lungs.

All these cases had the usual symptomatology of obstructive jaundice except for the last case. No case similar to the one recorded above has been found in the literature, in which a successful resection has been performed.

SUMMARY

1. A case of carcinoma of the head of the pancreas in a girl of 17 years of age is recorded.

2. The presenting symptoms were three episodes of intestinal hæmorrhage producing profound anæmia.

3. Obstruction of the pancreatic and biliary ducts was absent.

4. Successful pancreatico-duodenal resection was performed.

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GIANT CYST OF THE LIVER COMPLICATED BY RUPTURE

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SOLITARY cyst of the liver is a rare condition, but one of interest because of the diagnostic difficulties which it occasions and also because of the technical problems of intrahepatic surgery which will be encountered if enucleation is attempted.

PATHOLOGY

The accounts in the literature probably give a false impression of the frequency of solitary hepatic cysts, for such a dramatic condition rarely escapes being recorded. In 1923 Jones collected and reviewed 61 cases, and by 1937 Davis was able to review 187 cases of solitary cyst of the liver. In 1950 Caravati, Watts, Hopkins, and Kelly estimated that the number of recorded cases was still less than 200. A surgeon in his lifetime will be fortunate if he encounters more than a single case.

The pathogenesis remains obscure, but it is probably a congenital abnormality although quite distinct from multicystic disease which frequently affects other viscera. A number of cases have occurred in children and one of the earlier records, that of Bagot (1892), describes a case in which labour was interfered with by a huge cyst of the liver. Probably it is correct to regard the condition as a malformation, or hamartoma; the lining wall is usually of epithelium, which suggests a connexion with bile-ducts, and the contents are clear or slightly turbid fluid. Some cases present in childhood and many in young adult life, but occasionally the evolution may be very slow and the clinical manifestations are not seen until later years. The oldest recorded case is that of Bland-Sutton (1905), who recorded a large solitary cyst of the liver in a woman of 75 years. It was largely extrahepatic and easily removed. The more common site of origin is in the right lobe and the cyst usually presents through the inferior surface of the liver, with the anterior edge stretched over its surface. Many cysts are almost pedunculated and are connected to the liver by a mere tongue of tissue. Others, on the other hand, are buried deeply in the right lobe as well as extending far into the peritoneal cavity. The former can be treated with ease, but excision of those deeply situated in the liver presents greater difficulty.

DIAGNOSIS

The most striking feature of solitary cyst of the liver is the fact that it grows to an immense size and causes a gradual but symptomless enlargement of the abdomen. This is the most frequent symptom which brings the patient to hospital, and the usual problem is that of diagnosis of a large cystic swelling. When the cyst reaches down to the lower abdomen, but has a clear lower margin, the other conditions which may be diagnosed are mesenteric or pancreatic cyst, hydronephrosis, or mucocele of the gall-bladder. Pyelography and cholecystography will exclude the two latter conditions. The position of the cyst as shown by the soft-tissue shadow on straight radiography, and its relation to the gall-bladder and stomach, may help in distinguishing the other upper abdominal cysts. When the cyst is very great it reaches the pelvis. Here it may be felt on vaginal examination, and Jennings (1939) described a case in which there was dyspareunia. Such a cyst is almost certain to be diagnosed as ovarian in origin and a number have been operated on in error by gynæcologists.

One of the earliest of such records is that of Cousins, who described an operation in 1874. The lower abdomen of a woman of 27 was opened under chloroform anæsthesia. A gargantuan tumour containing 2½ gallons of fluid was tapped. It was then found that it was arising from the liver. The patient scarcely rallied from the operation and died thirty-six hours later. Autopsy confirmed its hepatic origin.

In the uncomplicated cyst no symptom other than swelling of the abdomen will be complained of, but when the cyst is of large size there may be a chronic dyspepsia which results from displacement of the stomach and duodenum. In other cases there may be attacks of obstructive jaundice as a result of compression of the common bile-duct. Such a case has been described by Caravati and his colleagues, who found 11 others in the literature.

Complications of solitary cyst of the liver are of very great rarity. When the cyst arises from a pedicle it is possible for it to undergo torsion, but the only record of this disaster is that of Orr and Thurstone (1927).

Sudden severe pain may result from hæmorrhage into the cyst, as described by Ackman and Rhea (1931). Rupture with discharge of its contents into the peritoneal cavity causes little irritation and the accompanying pain is not severe. This rare complication was encountered in the case recorded in this article.

CASE REPORT

Rose C., a married woman of 44 years, was admitted to the Bristol General Hospital on Feb. 9, 1953. She was complaining of pain of varying intensity in the right subcostal region. It had been present continuously for some two to three weeks. The pain was felt to go straight through to the back, but not to the shoulder. During the same period there had been a gradual increase in the size of the abdomen. For some two months prior to admission she had had heartburn, at times of considerable severity, which came on immediately after a meal and lasted about an hour.

There was no history of any previous illness except that she had been off work for a few weeks with a similar abdominal pain three years earlier.

Two days before she was admitted to hospital she struck her abdomen on the back of the seat of a bus and soon afterwards noticed a continuous aching pain in the abdomen of a character different from that which she had experienced before. It was severe enough to interfere with sleep, and on the following night, her first in

hospital, the pain kept her awake all night. Early on the following morning the abdominal distension was noticed to be greatly reduced.

whole abdomen and pelvis. It was easily felt vaginally and not unnaturally a diagnosis of ovarian cyst was made. On the morning of operation, after she had had continuous

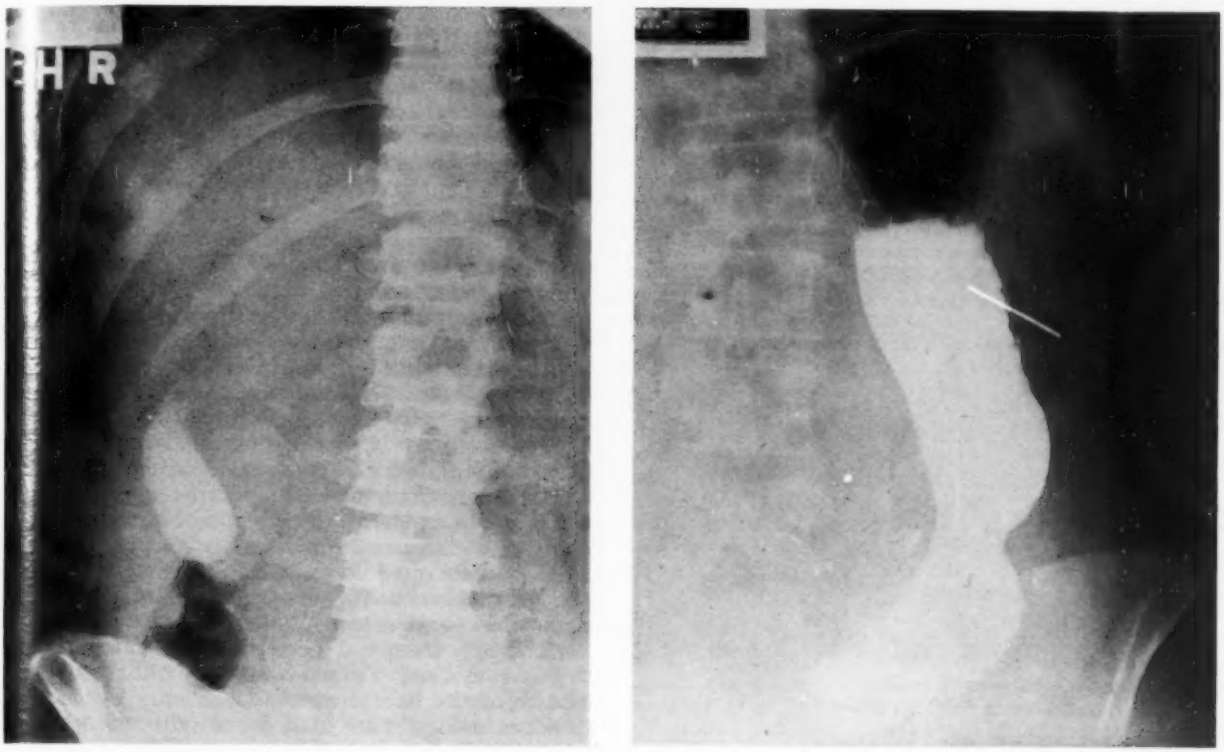
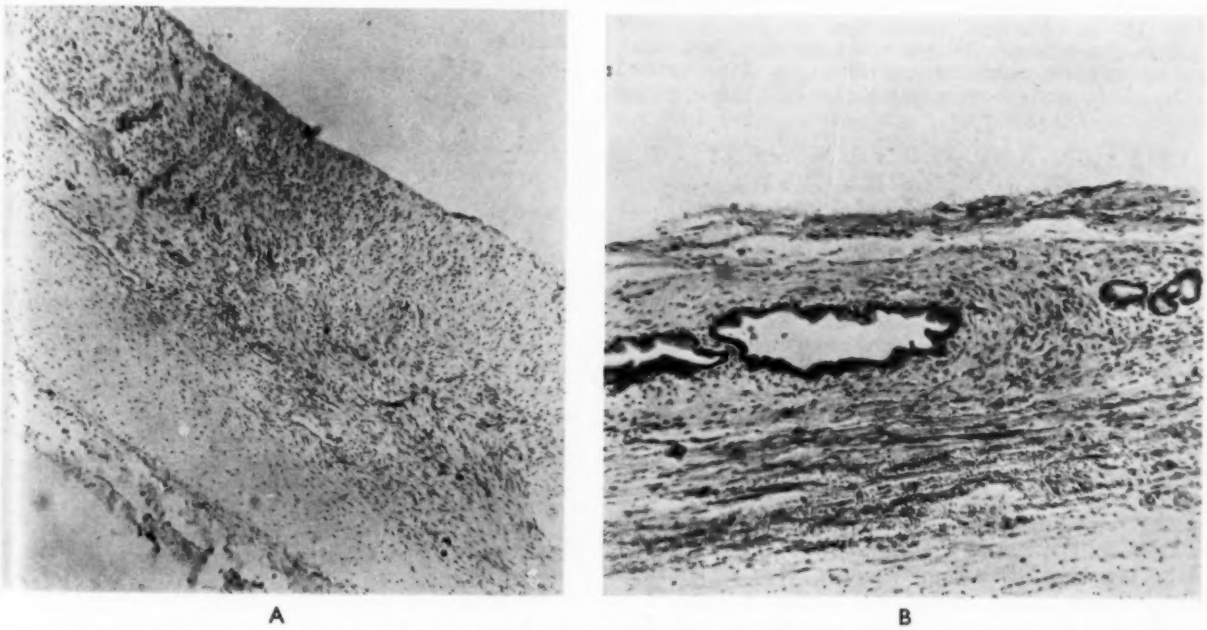


FIG. 529.—This illustrates the displacement of the stomach and gall-bladder. The general opaqueness of the films is due to the presence of the cyst.



A B

FIG. 530.—Microphotographs to show (A) the fibrocellular structure of the cyst wall, and (B) tubules lined with columnar epithelium.

ON EXAMINATION.—The abnormal signs were confined to the abdomen. When seen in the Out-patient Department there was a large cystic swelling occupying the abdominal pain for forty-eight hours, the lump was much smaller and less easily felt. Rupture of the cyst was diagnosed and immediate laparotomy advised.

AT OPERATION.—This was performed by Mr. T. F. Redman, who explored the lower abdomen. The abdomen contained a quantity of fluid and the cyst was found to be ruptured. It was taking origin from the right lobe of the liver; the pelvic viscera were normal. The abdomen was closed after evacuation of the cyst and sealing the opening with an omental plug. The patient was later transferred to the Department of Surgery at the Bristol Royal Infirmary.

On examination some fourteen days after this operation it was possible to feel a large cystic mass in the upper abdomen, rather to the right of the midline. It was a good deal smaller, however, than before the operation and the lower border could be defined in the abdomen. Radiographs (*Fig.* 529) showed that the stomach and gall-bladder were considerably displaced.

SECOND OPERATION.—On March 6, the upper abdomen was explored through a right upper paramedian incision. The cyst presented as soon as the abdomen was opened. For the most part it was thick walled, but there were a number of areas 1–2 cm. in diameter where the wall was very thin and bulging. One of these areas had been the site of rupture and was closed with a plug of omentum. The cyst was opened and the contents, pale slightly opalescent fluid, evacuated. The cyst was then dissected out of the right lobe of the liver, in which much of it was situated. The plane of dissection was kept close to the cyst and there was little bleeding. Large tributaries of the hepatic vessels to the cyst were deliberately ligated with fine thread. At the completion of the operation there was a huge defect in the right lobe of the liver which was represented as a thin shell of tissue. The walls of the defect were approximated with catgut sutures and a drain left down to the operative site. Her post-operative course was without special incident.

Nine months after the operation she was in good health, though complaining of occasional dull pain in the right subcostal region. The heartburn of which she had complained had been completely relieved.

HISTOLOGICAL EXAMINATION (Dr. Lloyd and Dr. Taylor).—The cyst wall was a fibrocellular structure with a good deal of collagen. There was no epithelial lining (*Fig.* 530 A). Further examination of the cyst wall showed the presence of numerous tubules lined with cubical and low columnar epithelium, in places several layers thick, and showing resemblance to biliary tract epithelium (*Fig.* 530 B).

COMMENTARY ON TREATMENT OF INTRAHEPATIC CYST

A study of the reported cases of solitary cyst of the liver discloses that dissection of the intrahepatic cyst has generally been avoided. When the cyst has been pedunculated it has been removed by placing one or more clamps across the tongue of tissue connecting the liver to the cyst, but when there has been an extensive intrahepatic extension other methods of treatment have been used. B. J. Davis (1939) records a case in which Carnoy's fluid was injected into a cyst. Such treatment can hardly be satisfactory as a rule, and in this case the follow-up extended to only four months. More often the cyst has been marsupialized after excision of the excess of cyst wall lying outside the liver. A prolonged illness is inevitable and a permanent sinus is a possible complication of this operation.

The fear that a high mortality would attend intrahepatic dissection probably accounts for the more conservative measures which have often been adopted. It is therefore remarkable that as long ago as 1899 Keen was able to compile a table of 75 cases in which resection of the liver had been carried out. He himself described a case in which a tumour, later found to be a carcinoma, was confined to the left lobe of the liver. The whole of the left lobe was removed, using the Paquelin cautery, and five ligatures were applied to larger vessels which were cut across. The immediate post-operative course of this patient was uneventful, but a long follow-up was not given. Grey Turner commented in 1923 that he was prepared to resect parts of the liver for local malignant disease, and described an operation of resection of a large adenoma of the liver. Wangensteen (1943 and 1945) and Raven (1947) have also called attention to the possibilities of resecting liver metastases in cases of carcinoma of the stomach and colon.

The incision is made into the liver substance with a knife after the insertion of mattress sutures to control oozing. Branches of the hepatic artery bleed freely and are picked up with artery forceps and tied with fine silk or thread. The cavity in the liver is obliterated as much as possible by suture and drained because of almost inevitable though temporary leakage of bile.

The opportunity to perform a liver resection is a rare one, as Grey Turner commented, for malignant disease of the liver is rarely localized. But benign tumours and cysts are ideal for intrahepatic surgery, and with modern anæsthesia and treatment of shock lesser methods should rarely be considered. In enucleating a cyst it is possible to keep close to the cyst and avoid cutting freely into the liver parenchyma. The insertion of controlling stitches is therefore unnecessary, but large vessels passing to the cyst wall will require deliberate ligation and the resulting cavity should be obliterated as completely as is possible by sutures.

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FIBROMA OF THE SPERMATIC CORD

By S. H. JACKSON and A. F. ROBINSON
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Although it is recognized that solid tumours are more common in the spermatic cord than in the epididymis, primary new growths of the cord are clinical rarities and the exact diagnosis is usually not made until they have been excised. The case reported here is one of cord fibroma, and is of interest principally because at operation it appeared to originate from the obliterated processus vaginalis. Not all primary cord tumours have a traceable origin from a particular tissue or component of the cord, although in the case of the fibromata the site of origin is generally given as in connective tissue in the cord near the epididymis. Other tumours have been described as arising from the vas, cremaster muscle, and pampiniform plexus. Young and Davis (1926), quoting Hinman and Gibson (1924), pointed out that 70 per cent are benign, by far the commonest type being the lipoma—meaning a true tumour and excluding protrusions of extraperitoneal fat. They mention that fibromata and sarcomata occur in appreciable numbers, and also that 90 per cent of all extratesticular scrotal tumours are tumours of the spermatic cord. This is the general American experience, as found by Thompson (1936) and Schulte, McDonald, and Priestley (1939). There is little in the British literature on the subject, probably because of the rarity of the tumours, which according to Ogilvie (1948) are much the least common cause of cord swellings. At our own

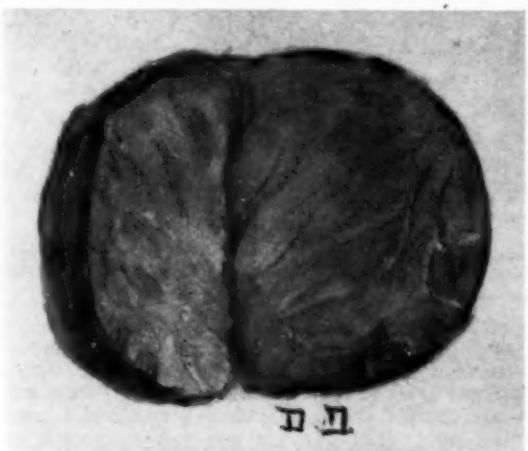

FIG. 531.—Drawing of the tumour. (Approximately × 4.)

hospital a search of the records showed that in the last four years this case had been the only one of cord tumour.

CASE REPORT

A fit and healthy young man of 23 was seen in October, 1950, complaining of a painless lump in the upper part of the left scrotal sac. The lump had been present for three years, had grown gradually bigger, and had been noticed occasionally to move upwards to near the external inguinal ring.

Examination showed a hard lobulated non-transilluminable rounded tumour, 1 in. by ¾ in. in size, lying in the left spermatic cord about 1 in. above the left epididymis. The testis and epididymis themselves felt normal.

The tumour was judged to be solid in nature and a clinical diagnosis of fibromyoma was made. Excision was advised.

FIG. 532.—Section showing thin-walled blood-sinuses and collagenized fibrous tissue. H. and E. (× 375.)

AT OPERATION (Nov. 1).—Under general anæsthesia an incision 1 in. long was made directly over the tumour, which lay deep to the coverings of the cord. The tumour itself was attached in the cord by a fibrous band, apparently continuous with the fibrous remnant of the obliterated processus vaginalis, and also by a small artery and vein. After division of these three structures the encapsulated tumour (*Fig.* 531) was easily removed. The wound healed rapidly and the patient was discharged home on the sixth post-operative day with the sutures out.

MICROSCOPICAL REPORT (S. H. J.).—The tumour is a rather vascular fibroma with considerable amounts of collagen distributed rather patchily throughout (*Fig.* 532). The blood-vessels are mostly thin-walled sinuses surrounded by condensed fibrous tissue or by lymphoid tissue. Occasional islands of lymphoid tissue are also present, and these stand out clearly when the section is stained for reticulin by Gormori's method.

There are no muscle- or nerve-fibres. Plasma cells are present in considerable numbers and there are occasional multilobed neutrophil polymorphonuclear cells.

Our thanks are due to Mr. R. L. Holt, under whose care this case was admitted, and we are indebted to Miss D. Davison for the drawing reproduced in *Fig.* 531.

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A LARGE LEIOMYOMA OF THE MEDIASTINUM

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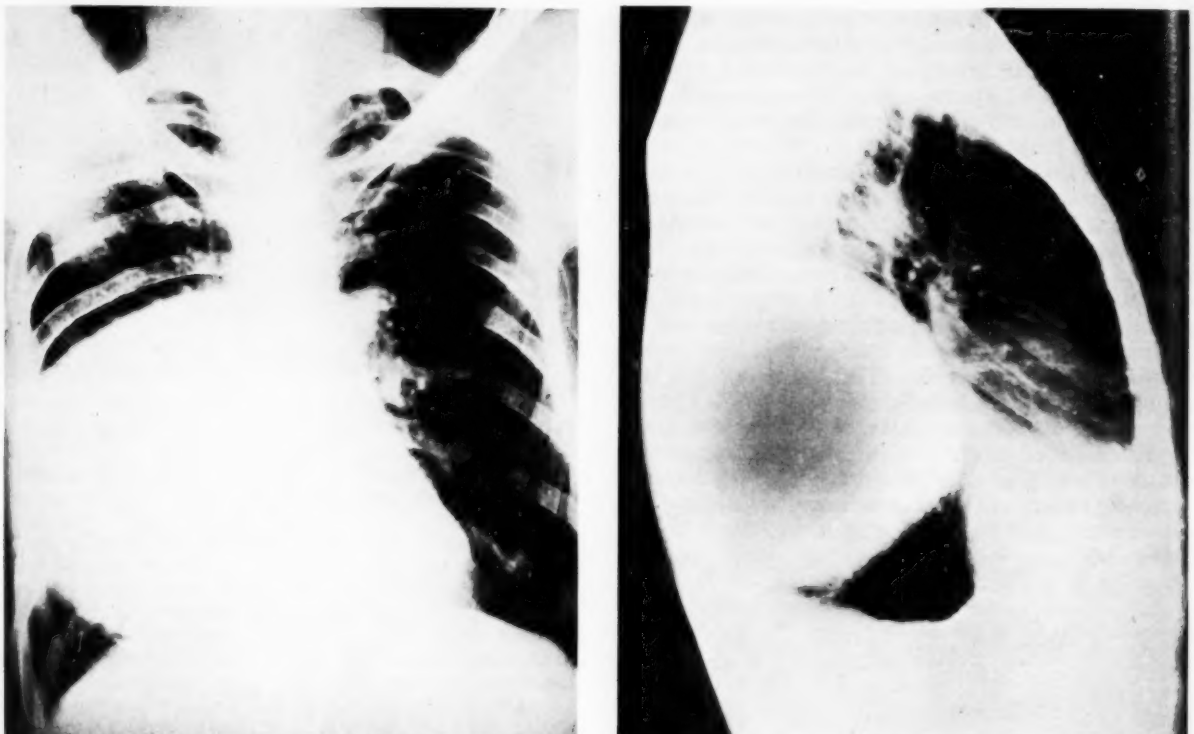
Leiomyomas of the mediastinum are so infrequently met with that the following case may be of interest. Catron (1931) and Kaplan (1934) have reported such tumours in the pleura and near the great vessels in the vicinity of the heart respectively. In the present case, although the tumour was very large, it was possible to remove it surgically, the patient making an uneventful recovery, but its exact site of origin could not be ascertained at the operation.



A B

Fig. 533.—A, Radiograph (anteroposterior view) showing circular opacity in lower part of right chest. B, Radiograph (lateral view) showing position of the opacity in the posterior part of the chest.

CASE REPORT

A Sinhalese male, aged 56 years, was admitted to the General Hospital, Colombo, on May 6, 1952, complaining of pain in the chest and fever of two weeks' duration. For the last two years he had suffered from attacks of wheezing.

On Examination.—He was emaciated. There was neither dyspnœa nor dysphagia. No cardiac displacement could be detected clinically. There was diminished movement of the right side of the chest, the percussion note was dull, and the breath-sounds were absent at the right base. Repeated examination of the sputum failed to reveal acid-fast bacilli.

Radiographs showed a circular opacity occupying the posterior and inferior aspects of the right side of the chest. (*Fig.* 533.) The appearances suggested a mediastinal tumour or a cyst.

At Operation.—Right lateral thoracotomy with resection of the eighth rib was performed under general anæsthesia with controlled respiration on May 18. There was a large encapsulated tumour about the size of a grape-fruit adherent to the parietal pleura, particularly in the region of the right paravertebral gutter. The tumour was extrapleural, the pleura being closely incorporated with the capsule over the upper and medial aspects of the tumour. The right lung was displaced upwards and compressed and its base was adherent to the tumour medially. In shelling out the tumour a thin outer layer of adventitial connective tissue was left behind, strands of it extending towards the posterior mediastinum. The tumour was not connected to the bronchus.

Convalescence was uneventful. Full respiratory movements returned and breath-sounds at the right base became audible soon after the operation. Drainage of the pleural cavity was discontinued in four days and the patient made a complete recovery. He was last seen on August 28, 1952, and was found to be quite healthy.

Description of Tumour (*Fig.* 534).—The tumour measured 14 cm. by 10 cm. and weighed 900 g. It had a fairly smooth surface and was invested by a connective-tissue capsule. It was of a firm consistence and its sectioned surface showed a whorled appearance.

Histology (*Fig.* 535).—The tumour was composed of interlacing bundles of spindle-shaped smooth muscle

cells arranged in a more or less parallel manner. Interspersed between the muscle cells there was much connective tissue. The muscle and fibrous tissue were distinguished from each other by staining sections with Mallory's and van Gieson's stains.

DISCUSSION

The site of origin of this tumour could not be ascertained at the operation and histological study of several sections also failed to provide any evidence on this point. The tumour was not connected with the bronchus or the great vessels, but an œsophageal origin could not be definitely excluded, for if the tumour arose from the smooth muscle of the œsophagus and became pedunculated during its growth towards the right side of the chest its point of attachment to the œsophagus would be difficult or impossible to define at an operation. In this case the tumour shelved out quite easily from an investment of connective-tissue strands which extended to the posterior mediastinum. It was not possible to ascertain whether these strands had any connexion with the œsophagus.

FIG. 534.—Macroscopical appearance of the tumour (sectioned surface seen on left).

Histological differentiation between the pure fibroma and the myoma with an admixture of connective tissue is sometimes difficult. This point has to be kept in mind when confronted with a large mediastinal tumour, because fibromas are known to arise anywhere in the mediastinum and grow to a considerable size (Foot, 1945). In this case, however, such a difficulty did not arise as the smooth muscle tissue in the tumour stained with Mallory's and van Gieson's stains.

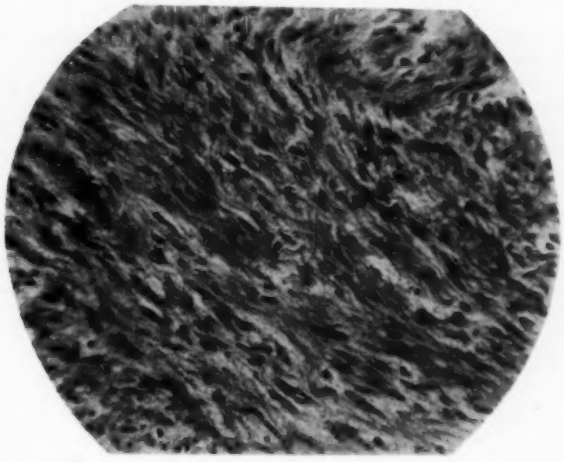


FIG. 535.—Section of tumour showing smooth muscle cells. H. and E. (× 280.)

SUMMARY

A case is reported of a large mediastinal leiomyoma which was successfully removed.

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REVIEWS AND NOTICES OF BOOKS

Surgery of Trauma. Edited by WARNER F. BOWERS, Colonel, M.C., U.S.A., formerly Chief Surgical Consultant, Office of the Surgeon General. With Forewords by MELVIN A. CASBERG and the Surgeons General of the Army, the Navy, and the Air Force. 7 × 10 in. Pp. 605 + xxviii, with 284 illustrations. 1953. Philadelphia and London: J. B. Lippincott Co. £6.

THERE can be no doubt whatever concerning the importance of traumatic surgery in the modern world to-day for it is a traumatic age in which we live. This large volume is devoted to this branch of surgery and covers all its aspects. The second world war and the more recent war in Korea have provided surgeons with men who have sustained many and varied forms of wounds. The roads of every country, including England, still take a heavy toll of life and leave each year a vast number of injured people. The motor-car, both large and small, is largely responsible for these accidents. Burns, too, are all too common to-day and are becoming a menace.

In this book the Army and Civilian surgeon have co-operated to the fullest extent.

The various physiological aspects of shock and the use of blood, blood-plasma, and blood substitutes have been incorporated. The importance of frost-bite in the wounded is an aspect which has not been considered before, yet it played an important part in the war in Korea. Amputations still rank high in both military and civil surgery following various forms of trauma, and wherever possible conservation should prevail.

This book covers in a very complete way the various kinds of trauma from craniocerebral injuries to burns of the body; and is most comprehensive. The illustrations are numerous and good and a large number show wounds produced by modern weapons.

The contributors are experts in their respective fields and have produced a book which will be read by all those who have to treat traumatic cases.

Recurrent Dislocation of the Shoulder. By JAMES A. DICKSON, M.D., ALFRED W. HUMPHRIES, M.D., and HARRY W. O'DELL. Pp. vi + 158, with 78 illustrations. Baltimore: The Williams & Wilkins Co. (London: Baillière, Tindall & Cox.) 35s.

THIS is a timely and attractively written monograph on a subject of practical importance. The authors have reviewed in some detail the anatomical and pathological factors concerned in the production of this disabling condition. They have also included a description of almost every operative procedure which has been practised for its cure, and have emphasized that success almost certainly depends on creating a permanent restriction of the range of external rotation in the shoulder. A short and useful chapter is devoted to a consideration of the mechanics and treatment of the rare recurrent posterior dislocations.

BOOK NOTICES

[*The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest to our readers.*]

Medical Electronics. By G. E. DONOVAN, M.D., M.Sc., D.P.H. 5¼ × 8½ in. Pp. 215 + x, with 36 illustrations. 1953. London: Butterworth & Co. (Publishers) Ltd. 30s.

Surgery of the Biliary Tract, Pancreas, and Spleen. By CHARLES B. PUESTOW, M.D., Ph.D. (Surg.), Chief, Surgical Service, Veterans' Administration Hospital, Hines, Ill.; Chief Surgeon, Henrotin Hospital, Chicago. 5½ × 8¼ in. Pp. 370, with 72 plates. 1953. Chicago. The Year Book Publishers Inc. (London: Interscience Publishers Ltd.) 68s.

Methods of Examination in Ear, Nose and Throat. By W. G. SCOTT-BROWN, C.V.O., M.D., B.Ch., F.R.C.S., Ear, Nose and Throat Surgeon, Royal Free Hospital, London. 5⅜ × 8½ in. Pp. 110 + ix, with 94 illustrations. 1953. London: Butterworth & Co. (Publishers) Ltd.

Ferdinand Sauerbruch. A Surgeon's Life. Translated by FERNAND G. RENIER and ANNE CLIFF. 5¼ × 8⅜ in. Pp. 297. Illustrated. 1953. London: Andre Deutsch Ltd. 15s.

Peptic Ulcer. By C. F. W. ILLINGWORTH, C.B.E., M.D., Ch.M., F.R.C.S.E., F.R.F.P.S. (Glas.). Regius Professor of Surgery, University of Glasgow; Surgeon, Western Infirmary, Glasgow. 6¾ × 9¾ in. Pp. 287 + viii, with 89 illustrations. 1953. Edinburgh and London: E. & S. Livingstone Ltd. 42s.

Diagnosis of Acute Abdominal Pain. By WILLIAM REQUARTH, M.D., Clinical Assistant Professor of Surgery, University of Illinois College of Medicine. With a Foreword by WARREN H. COLE, M.D. 5½ × 8 in. Pp. 243, with 79 illustrations. 1953. Chicago: Year Book Publishers Inc. (London: Interscience Publishers Ltd.) 38s.